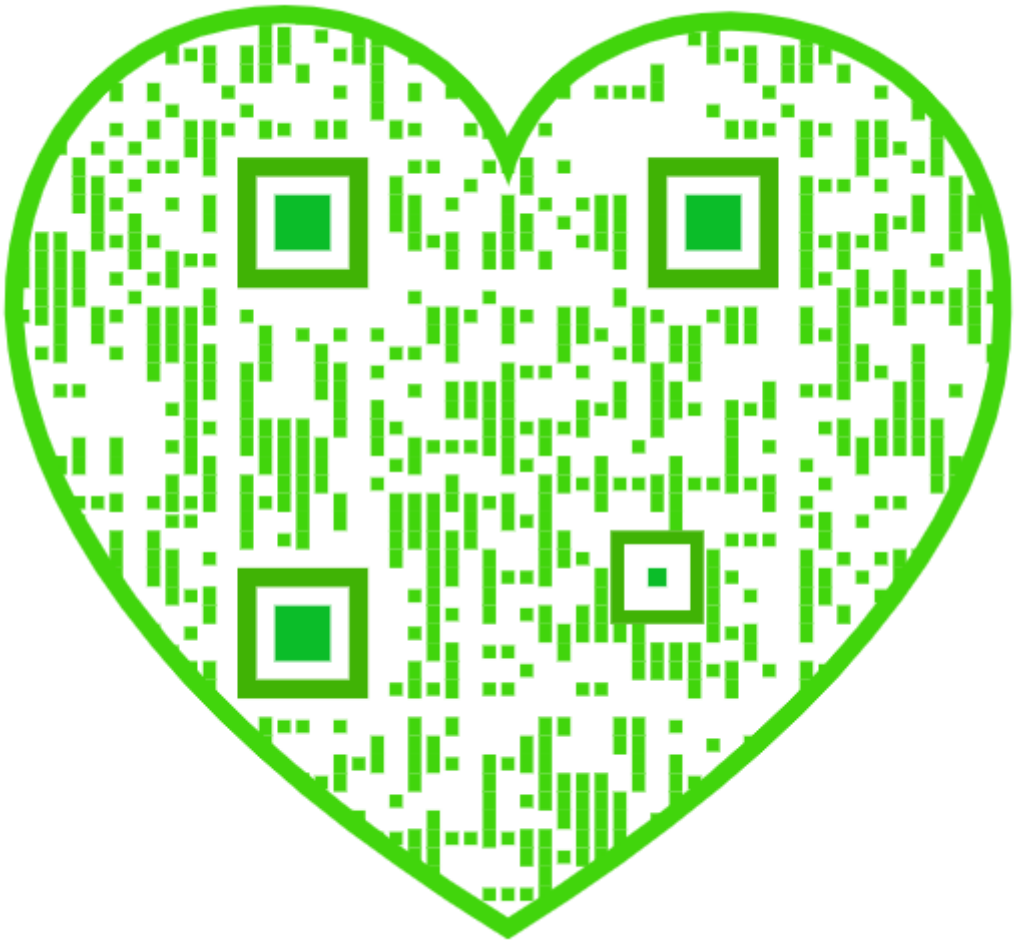

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VETERINARY PRACTITIONERS' SERIES
NO. 2

SWINE PRACTICE

BY

A. T. KINSLEY, M. Sc., D. V. S.

Author of Veterinary Pathology,
Swine Diseases, Etc.

Illustrated

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PREFACE

The increasing importance of the swine industry demands increased efficiency in swine practice, and this is briefly the reason for the publication of this book at this time.

The original edition of "Swine Diseases" has been materially increased by the addition of chapters on the general care and management of swine, breeds of swine, surgical operations and obstetrics; in fact, the author has attempted to briefly and clearly describe all phases of the management and diseases of swine in such a way that the student of veterinary medicine, municipal, state and Bureau of Animal Industry veterinarians, and the veterinary practitioner will find it a valuable ready reference. Because of the detailed description of methods of treatment it has been deemed advisable to change the title of the revised edition to "Swine Practice".

The author has freely consulted the various textbooks, periodicals and experiment station publications, bearing upon the subject of management and diseases of swine. To his publisher, D. M. Campbell, the author desires to express his appreciation.

A. T. Kinsley.

Kansas City, Mo.

CHAPTER I

GENERAL SWINE MANAGEMENT

Care of Stock Hogs.
Breeds of Swine.
Feeds and Feeding.
Sanitation.
General Diagnosis.
Autopsy.
Restraint.
Medication.
Anesthesia.

Importance of Swine Industry

SWINE raising has for many decades been a very important occupation in practically all civilized countries. The essential food that caused so much concern, because of its scarcity, during the recent world war was fat; and pork is the chief source of that valuable product.

The most intensive swine raising and feeding in the United States, have been largely confined to the great corn belt, but this may be changed in the future because of the splendid packing and transportation facilities and efficiently developed methods of immunization of swine against hog cholera and other swine diseases. Thus it is now possible to produce pigs in large numbers in sections of the country where insufficient grain is raised to finish the fattening, because these pigs can be sold at market centers, for a good profit to the producer, immunized and sent to the corn belt to farmers where they are full fed and marketed as fat hogs.

Swine are sold for pork, feeders or breeding stock. The largest number of swine are sold for pork and this naturally includes those swine that were purchased as feeders.

The number of breeding hogs has increased by leaps and bounds in recent years and the veterinary practitioner should familiarize himself with the problems concerned in the general management of swine.

The advice a veterinarian gives to his client relative to problems in swine husbandry will necessarily vary according to location and will probably depend to some extent upon the local crop conditions. Many farmers and ranchmen in the semi-arid sections of the country could produce feeder pigs at a profit and it should be the business of veterinarians to give information and even demonstrate the feasibility of such a plan. Veterinarians in the corn belt, on the other

hand, will find the problems concerned in fattening of hogs and the production of breeding hogs of paramount importance.

CHOICE OF BREED

The breed of hog to be selected is a matter of personal choice with the breeder. In the middle west, the Poland China and Duroc-Jersey are the most popular breeds, although practically all breeds have their admirers. In recent years the demand for lighter hogs instead of the very fat animals that formerly topped the market has given great impetus to the raising of Hampshires and other semi-bacon types.

Many breeders do not consider it necessary to use pure-bred sows in the production of market hogs. However, there seems to be no question among breeders but that pure-bred boars should be used. The grade sow and the pure-bred boar for the production of market hogs are especially favored by the breeders who are limited as to capital. It is also the usual procedure with beginners in the industry. The selection of the breeds is largely a matter of choice with the individual, although we find a great many that favor the pure-bred Poland China boar with the grade Duroc sow, but further investigation may show an equal number favoring the pure-bred Duroc boar and the grade Poland China sow. The desideratum is—good feeding qualities, early maturity and prolific females.

Inbreeding is a question on which the veterinarian is frequently consulted. Inbreeding once removed is permissible, but continuous inbreeding is usually hazardous as weakly, deformed pigs are likely to result.

Line-breeding is the mating of related animals that have descended from the same common ancestry. Thus, the defect of inbreeding may also appear in line breeding but by careful selection of the individual, line breeding has been found to be of value in emphasizing the good points of a particular strain of any breed of hogs.

Cross-breeding is the mating of pure-bred animals of different breeds. This breeding produces a thrifty and usually hardy type with the first cross but when continued further the progeny degenerates to uncertain types, a large number being scrubs.

Grade breeding is the mating of a pure-bred boar with grade sows. If grade breeding is continued sufficiently long, practically a pure-

bred herd can be established. However, this method of creating a pure-bred herd is objectionable because of the length of time required.

AGE FOR MATING

The age for mating animals is a question of considerable interest and importance, but from general observation it would appear that mature animals of about the same age generally produce best results. Frequent difficulties arise, particularly in farrowing, when young sows are mated with aged boars, and this should be avoided so far as possible. The mating of aged sows with young boars is attended with fair success, although a mature boar usually produces stronger pigs and a larger litter.

The length of time to keep breeding animals is also an important question with breeders. Up to four or five years of age is usually the most profitable length of time for the breeding period of both male and female. The best age at which a boar should be put into service varies somewhat, according to the breed of hogs. Generally speaking, such animals should not be used under nine or ten months of age.

Some sows will not take the boar during the period of estrum and others are bred with considerable difficulty. Such sows are of no value as breeding animals unless they produce pigs. This type of sow diminishes the vitality of the boar. It is sometimes desirable to breed a small sow to a large boar or a large sow to a small boar. These various breeding difficulties are largely overcome by the use of a breeding crate. Many different types of breeding crates have been devised. The type selected should be so constructed that it will be convenient and fulfill the requirements. In constructing a breeding crate, the one important feature that should be provided is that the sow will be in a natural position when confined in the crate.

SELECTION OF HERD BOAR

The quality of a herd boar should be carefully recognized and generally the points sought by the successful breeder are: big bone, large for his age, a long, wide, deep body, properly developed back, short neck and head, wide deep chest, low hams, short legs, and good feet. He should stand well on his toes, have small ears and a wide space between the eyes, have the proper color, fine hair, good action, gentle disposition and show distinct masculinity.

Care of the boar is also of prime importance for success to the

breeder. In fact, the length of time of usefulness of such an animal is determined largely by the care in maintenance. The frequency of service of the boar varies with individuals and particularly according to their age. A young boar may be put to service every second or third day; whereas a mature boar may be put to service once or twice daily. Boars should be kept separate and in the summer time should be provided with a small pasture, and supplied plenty of fresh water. Winter care should include warm housing, with plenty of bedding and a maintenance ration. A common mistake of breeders is that of keeping their herd boar too fat. Another very important consideration for health and prolonging the period of productivity of boars is in requiring them to take ample exercise. Boars should

Fig. 1. Farrowing House at Longview Farms.

not be kept in small pens. Most breeders provide a small pasture for their breeding boars. If a large lot or a pasture is not available, feeding should be done in one end of the pen and the water supply kept in the opposite end which will necessitate the taking of some exercise to obtain feed and water.

In the selection of a herd boar, the appearance and development of the testicles should not be overlooked. Cryptorchids or boars in which either or both testicles have not descended into the scrotum should be rejected. Cryptorchidism, although usually of congenital origin, is a malformation that is frequently transmitted to the male progeny. "About 5 per cent of the male progeny of one of Missouri's most famous boars, Chief Tecumseh II, were cryptorchids. Liberty

Chief and Chief I Know, two boars sired by Chief Tecumseh II, were noted boars and from 3 to 5 per cent of their male get were cryptorchids. Chief Perfection II, sired by Chief Tecumseh II, was the sire of Cherokee Perfection, which in turn sired about 3 per cent of cryptorchids. Thus this structural defect appeared in at least three generations.''

THE BROOD SOW

The quality required in the sow is, of course, practically analogous to that required for the boar. The general contour and appearance should be strongly feminine, otherwise marks of identification should be as indicated in the male. The udder should be well formed and

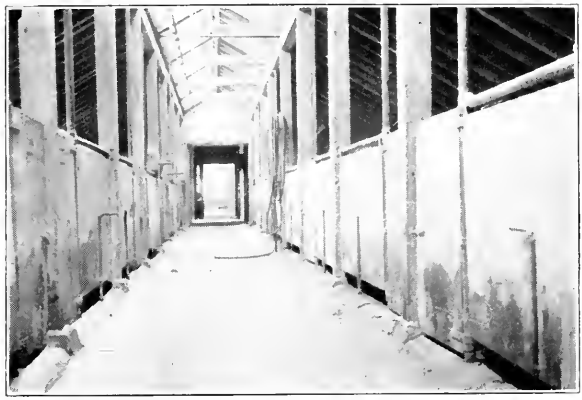


Fig. 2. Interior of farrowing house—more expensive than practical.

provided with ten or twelve teats, distinctly defined, and these should extend well forward and backward and be wide apart. Most breeders claim that sows from mature animals are the best breeders. The most prolific age in sows is from two to four years. Many breeders breed gilts once and then fatten them for market, believing it to be profitable. It would be better and more profitable if these breeders would select from such gilts those that are prolific and good breeders and keep them for breeding until they are at least four years of age, rather than to trust to the single breeding as some have done in the past. Gilts should not be bred until they are nine or ten months of age.

Whether or not the breeder should produce two litters of pigs a

year depends entirely upon circumstances. A large percentage of the breeders so arrange their schedule that two litters can be produced each year and thus apparently make the breeding business much more profitable. The care of the brood sow is practically the same as that of the boar, except that several sows may be maintained in the same enclosure during both winter and summer months, or during the entire year, excepting the farrowing season and for three or four weeks thereafter.

The dates for farrowing should be carefully considered and will necessarily vary according to whether the breeder is desirous of producing two litters per year or one, and will depend on climate and the housing facilities on the farm. In the middle west, where two litters are produced annually, the majority of breeders favor the dates between the middle of March and the middle of April for the first litter and the middle of September to the middle of October for the second litter. When different dates than the above are selected, particularly for the spring litter and especially in the northern countries, the breeder must be certain that he has the facilities for keeping the small pigs properly sheltered from inclement weather. A few breeders will naturally select other dates than those indicated and perhaps have goods reasons for so doing.

When breeders have several sows, they usually prefer to have them all farrow about the same time, to economize labor in the care of the pigs. This, of course, is ordinarily advisable. The provision for farrowing, particularly as to housing, is very important. Most successful breeders now favor the individual hog house, and this is certainly profitable where surroundings and climatic conditions will permit. As to the type of house, there is a variety of opinions but if the house is so constructed that it will protect against inclement weather and be so arranged that there is good drainage and that the pigs can be protected from the sow crushing them, it will meet all of the usual requirements. For early spring farrowing, some pure-bred breeders have provided heated hog houses, containing several individual pens without outside runs, which is of course a desirable method but relatively expensive. The single farrowing house is most desirable for grade breeding and particularly where a large number of hogs are kept on the same farm every year.

The period of estrum occurs in the sow every twenty-one days until she conceives. The absence of the period of estrum is the first indication of pregnancy. Sows usually begin to fill in the flank and

show piggy in about six weeks after conception. The period of gestation is from 112 to 120 days.

FARROWING

The breeder who does not isolate the sows from the general herd for farrowing and who does not provide clean and relatively sanitary quarters, will not be successful in raising pigs.

For the best results, sows should have a change of diet about two weeks before farrowing, by reducing the fat forming foods and increasing the muscle and bone forming elements. The ration should be rather limited and should be of a laxative nature. Where feasible, alfalfa hay or meal will be found to be a splendid diet, particularly when combined with skim milk. Needless to say, a change of diet should be rather gradual and not sudden.

Fig. 3. One-sow farrowing houses.

The farrowing house should contain a good quality of bedding, but this should not be used extravagantly, as a limited amount of bedding is more desirable than heavy bedding. The bedding materail should be clean and not contain fibers or straws that are long and in which the little pigs might become entangled.

Sometimes, sows, particularly young ones, may have difficulty in delivery, and in such cases provision must be made in order that the life of the dam and pigs both will be saved. The veterinarian should advise his client that such cases should be seen immediately when it is determined whether or not it will be necessary to perform a cesarean section. Some veterinarians have provided a special room in their hospital in which this operation is conducted, the farmers delivering patients direct to them. In this way, the veterinarian can perform the operation for a reasonable fee and he has the surround-

ings in which the best possible service can be given. The use of forceps may be indicated, but each case is distinct within itself and it is not possible to give positive directions for such operations.

Good breeders see that each pig begins breathing, and when necessary artificial respiraton is resorted to. Also each pig is required to suckle, and chilling of the recently farrowed pig is prevented.

Pig eating sows are sometimes observed. This habit is usually the result of improper diet. It can usually be prevented by providing proper feed, although when a sow has formed the habit it is difficult to cure it and it may be necessary to fatten the sow for slaughter.

Fig. 4. CESAREAN SECTION. Photograph taken seven days after the sow was delivered of seven pigs by laparotomy.

Proper care of the suckling pig is necessary. They usually require considerable attention for about the first ten days.

In recent years it seems probable that as much as 30 per cent of the spring crop of pigs has been lost. These extensive losses were due to a variety of conditions, the most important of which were abortion, scour, parasitism, pneumonia, swine plague and goiter.

Abortion is becoming a serious menace to the swine industry. A detailed description of this disease appears elsewhere. Suffice is to say at this time that it appears to be of an infectious nature. Aborting sows should be isolated and this is one important factor that favors the individual farrowing house and separate pens for each sow and her litter. Breeders should be urged to divide their brood sows into small lots.

Pig scour may be intimately associated with abortion disease in the sow. It has also been found that digestive derangement result-

ing in diarrhea may be caused by B. suisepticus, B. suipestifer, B. paratyphoid, B. enteritidis and colon bacillus, and probably also some other microbian agents. In some isolated cases, scour in pigs has been found to be due to digestive derangement of the sow. This disease will also be discussed elsewhere in detail.

Scour due to various infecting microbian organisms may be largely prevented by providing sanitary surroundings for the brood sow and her litter. If the infection gains a foothold, the various indicated biologies combined with proper feeding and sanitary measures will be found to be of considerable value.

Parasitic pneumonia has been found to be a very potent factor in the loss of pigs. Losses incidental to this disease occur in pigs ten days of age and from that up to two or three months of age. The majority of cases of parasitic pneumonia in suckling pigs are due to the larval form of the ascarid. The life history of this parasite will be found detailed in the chapter on Intestinal Parasites. This loss in pigs can be prevented by elimination of parasites from the intestines of the brood sow prior to farrowing. It seems probable that these parasites may exist in a latent form for a considerable time in the soil. Hence, the successful breeder provides for a frequent change of lots.

Defective development of the thyroid gland has been found to be an important factor in some of the losses of the annual pig crop, particularly in some of the northern states. The exact cause of this condition has not yet been determined but it seems probable that the food of the brood sow is deficient in some necessary nutritive or growth element. This condition can be prevented by the administration of iodin or some of its salts to the brood sow, during the period of pregnancy. Because of the recurrence of this condition in succeeding years on the same farm, it seems justifiable to recommend iodin salts to the pregnant animals on that farm.

Brood sows while suckling pigs should be given a good ration, containing the elements that stimulate the flow of milk and provide sufficient bone and muscle-forming ingredients. A breeder can not expect a sow to produce a good litter of pigs on a ration insufficient to maintain her in good living condition.

The age for weaning pigs depends somewhat on the development and condition of the pigs. Generally speaking, pigs should be weaned at from ten to thirteen weeks of age. Most breeders diminish the milk-producing foods for the sow a few days prior to the time

of weaning, although a few breeders advocate the weaning of a few of the pigs at a time. This method is not, generally speaking, advisable. The sow and pigs usually do better if all of the pigs are weaned at the same time, and the pigs should be sufficiently separated from the sow, so that neither can hear nor see the other.

On the best regulated breeding and feeding farms the pigs are classified as soon as they are weaned, separating those desired for breeding purposes from those to be used for feeding. Some feeders prefer to even re-classify their feeding lots, claiming that they have found it profitable to market pigs that are all practically the same size and color. The feeding of the different classes of pigs will be essentially different. The fattening hogs will be given a fattening ration, whereas, the breeding hogs will be given a growing ration. It is always advisable to properly identify pure-bred pigs that are to be kept for breeding. Different tags are available for this purpose, the choice of which will depend entirely on the breeder.

Care of Stock Hogs

The successful handling of stock hogs is one of the most important problems of the live stock industry in the United States. There are many sections in which insufficient grain is raised to fatten hogs, but the climate and surroundings are such that pigs can be produced and transported to those areas in which grain is raised in sufficient quantity to fatten more hogs than are normally produced in those areas.

It does not seem possible to change this state of affairs and consequently the extent of the production of feeder pigs will be largely determined by the success that feeders have with pigs delivered to their farms for feeding purposes. Many points must be considered in purchasing stock hogs. A brief description of the most important points follows:

Stock hogs have been raised in the country and shipped to market. It is not possible to know just what the surroundings have been from which and through which these hogs have passed before entering the market. If such hogs have been retained any great length of time in a hog buyer's yards, railroad stockyards or markets, they have had the opportunity of becoming infected with hog cholera and a variety of other conditions that are prone to affect swine.

The purchaser should use judgment and care in selecting hogs, to be certain that the hogs purchased are reasonably fresh from the farm and have not been retained for any great length of time before he acquires them. Government inspection safeguards the purchaser of stock hogs so far as is possbile, as all hogs showing any evidence of disease or rise of temperature are rejected. When a large number of a given lot are rejected, it is an indication that it has been some time since the hogs left the farm. The usual method of purchasing hogs through the commission firm is that the commission firm permits the owner to return all rejects at the same price per pound that he paid for them. This point should always be definitely understood by the purchaser and his commission man.

After the hogs have been purchased, the owner should be advised that they be given not only the serum and virus treatment, to immunize them against cholera, but also bacterin treatment, to protect the hogs so far as possible against the future development of infectious pneumonia or swine plague and also against necrotic enteritis or inflammation of the bowel. Experience has demonstrated that the so-called triple treatment has been of advantage to the shipper in that the losses have been less than in those shipments in which the hogs have been immunized only against cholera.

The purchaser should also instruct his commission man not to overload the cars, for overloaded cars result not only in lack of comfort, but actual damage to the hogs. Further provision should be made, particularly in the fall and winter months, to have the cars papered or provision made to protect the animals against inclement weather. The cars should also be provided with ample bedding, and the government requires that cars shall be cleaned and disinfected before used for such service. Shippers of stocker hogs will find that they will be materially benefited by taking care of the loading of cars, as indicated.

Unless the time limit requires, the hogs should not be unloaded and fed enroute, and when necessary to feed, explicit instructions should be given that the feed be relatively light. Provisions should be made for the arrival of the hogs at destination, in order that they may be given the best possible care. If the hogs have had a relatively long journey it will be best to put them in the railroad stockyards, seeing to it that they are well bedded and cared for until they have had an opportunity to rest and regain vitality. Similar provisions should be made on the farm; that is, particularly during

rainy or cold weather, ample bedding should be provided and the hogs kept in dry, protected quarters. During the grass season, if it is possible the hogs should be turned on pasture.

SUCCESS DEPENDS ON FEEDING

The feeding of recently immunized, shipped stock hogs is of vital importance and the handling during this stage frequently determines whether or not the shipper will be successful or lose money on the venture. Such hogs should receive a small ration not to exceed one-half of the usual feed and it should be of a good quality. This half ration should be maintained for a period of a week or ten days; in fact, the hogs should not be given full feed for two weeks and even longer if there is any indication of disease in the animals.

Should any evidence of disease of any character develop a careful examination should be made to determine what the condition is, in order that preventive measures may be established at once and to prohibit extensive losses. The diseases to which swine are most subject after immunization are hog cholera, infectious pneumonia or swine plague and infectious necrotic enteritis. Relatively few immunized stock hogs die of cholera, because the government regulations require that stock hogs be immunized with serum and virus made in establishments that are under government supervision and the immunization of stock hogs is under the direct supervision of one or more government veterinarians. Losses occuring from cholera due to impotent serum will occur in from the tenth to fifteenth day after immunization. Such conditions are usually manifested by a large percentage of the hogs showing evidence of disease at once. It is extremely difficult for a veterinarian to make a positive diagnosis of cholera in recently immunized hogs because the lesions attributed to hog cholera are also found in hogs that have been simultaneously immunized. The veterinarian should therefore be on his guard in making an examination of diseased conditions in stock hogs.

Infectious pneumonia or swine plague is probably responsible for a large percentage of the losses that occur in stock hogs, and the losses due to this disease usually occur in from twenty to thirty days after the hogs are purchased. This loss may occur in hogs that have received the swine plague bacterin, because one injection of the bacterin produces an immunity of relatively short duration and, therefore, it is always advisable, particularly during changeable weather, to give a second injection of the swine plague bacterin a few days

after their arrival on the farm, and some shippers have claimed that it is profitable to given even a third injection of the bacterin about a week after the second injection.

Swine plague is manifested in hogs by a cough, nasal discharge, thumps and general depression. As a rule, this disease does not spread as rapidly as cholera and only a few animals in the herd will be observed in the beginning. The disease gradually affects others until ultimately perhaps 50 to 75 per cent of the shipment will be affected. Swine plague is not as fatal as hog cholera but it is a serious disease, because it produces a loss in condition, and such animals require much more feed for fattening than those that have not been affected.

Infectious necrotic enteritis results from various organisms affecting the mucous membrane of the intestine and is evidenced by digestive disturbances consisting of irregular appetite, diarrhea, and the animals appear gaunt, weak and depressed. This disease, like swine plague, is not rapidly extended through a herd of hogs and is not as fatal as hog cholera, but is of very great economical significance because it produces a loss in condition that is expensive to overcome.

In conclusion, it may be said that the stock hog business will be profitable for the feeder, provided he uses care and judgment in the purchase of his hogs, in designating that they be given the triple treatment, not overloading the cars and seeing to it that the animals are protected in the car while enroute and are provided clean dry quarters at destination and ample rest before they are taken to the farm, and given proper feed thereafter.

Breeds of Swine

The number of hogs in the United States has varied from 60,000,000 to 76,000,000 in round numbers during the last decade. The exact number of registered pure-bred hogs in the United States is not known. According to the report of the secretary of the National Swine Growers' Association, there were 331,040 pure-bred hogs registered in 1918, and it is probable that there are less than one million pure-bred hogs registered in this country at this time. There are some pure-bred hogs that are not registered, but it is surprising that there is such a small percentage of hogs in this country that are pure-bred. At the present time, there are splendid opportunities for those interested in swine production to raise pure-bred hogs. Market fluctuations have little effect upon the price of pure-bred breeding

stock. Therefore, the producer of pure-bred swine has two outlets for his hogs, as they may be disposed of for breeding stock or for pork.

The scrub hog, i. e., the "razor-back" type, has been responsible for extensive losses on many farms, because such hogs consume more feed in proportion to the weight gained than pure-bred swine. The difference in the amount of feed necessary to finish scrub hogs and pure-bred hogs makes a good profit in favor of the pure-bred.

Many farmers and a few pure-bred breeders maintain that there will soon be an oversupply of pure-bred hogs and that the market will be glutted. There is no immediate danger of there being an oversupply of any breed of pure-bred hogs when it is considered that the ratio at present is, not to exceed, one pure-bred to seventy grades of scrubs.

One reason why the pure-bred swine are limited in number is probably due to a difference of opinion as to the required characteristics of a given breed. The breed organizations are in most instances amalgamating the views of the different breeders and thus obtaining unity of the breed.

The most popular type of swine in the United States is the so-called lard hog. It is the hog that when ready for slaughter contains a large amount of fat in the form of leaf lard and subcutaneous deposits. The bacon hog is more favored in other countries although they are becoming popular in this country and there are many breeders that are successfully breeding the bacon types of hogs.

The following is a brief description of the principal breeds of the lard type of swine.

POLAND CHINA

The Poland China hog appears, according to the early history of the breed, to have had its origin in southwest Ohio about 1816, although the name was not established until 1872.

Characteristics.—Head medium length and breadth, jowl rather full. Face straight, with very slight dishing. Cheeks full and rounding. Ears medium heavy to heavy and drooping. Neck medium short and thick. Shoulders smooth. Back moderately well arched, loins and ribs thickly covered. Sides long and deep. Hind quarter typified by thickness throughout the entire ham. Legs medium long, set well apart. Bone extra heavy. Hair straight and fine. Color

black with white points, although a few white hairs are not considered objectionable.

The Poland China is readily adapted to climate and feed in the corn belt or any other hog-growing section of the United States. They mature early, attain great weight at an early age on a minimum of feed, and for several years of late have held the records for prolificacy.

DUROC-JERSEY

Accurate information as the origin of the Duroc-Jersey breed does not seem to be of record, and while it is generally believed that this breed is strictly American there is evidence tending to indicate that the original stock was imported. The most reliable information obtainable shows that originally there were two distinct families or branches of this popular breed, known as "Jersey Reds" and "Durocs."

The family known as Jersey Reds was so named by Joseph B. Lyman, a resident of New Jersey and an agricultural editor of the *New York Tribune*, and the first man to advertise these hogs under this name was a Mr. Lippincott, of New Jersey.

The family known as "Durocs" was so called by Isaac Frink, of Milton, New York, to whom that name was suggested by the name of the noted stallion Duroc, owned by Harry Kelsey, of Florida, N. Y., on whose farm Mr. Frink saw a litter of ten red pigs, thought to have been the product of a pair of pigs either bought in New York or imported from England. The productive power of these pigs immediately brought them into prominence and farmers and hog growers generally began to breed them. In the course of time the two families were interbred and assumed the name of Duroc-Jerseys.

Characteristics.—Head relatively small. Face straight or only slightly dished. Nose medium. Ears medium, drooping forward. Eyes prominent. Back wide, well arched, ribs well sprung. Body deep and long. Shoulders fairly prominent, smooth, well fleshed. Hams heavy, thick, fleshed. Legs long rather than short, bone good. Color red of variable shades.

The Duroc-Jersey is adaptable to climate and feed conditions in the corn belt. This breed probably matures earlier than most other breeds. The breeding characteristics of the Duroc-Jersey are dis-

tinctly superior. The meat compares favorably with that of any other breed.

BERKSHIRE

The Berkshire hog is a native of the south central part of England. According to history, the Berkshire was first introduced into the United States in 1823 by John Brentnall of New Jersey.

Characteristics.—Head appears large and broad. Face medium length with distinct but graceful dishing. Ears erect or carried slightly forward. Back medium breadth, straight, ribs fairly ordered. Rump long and level, tail set high. Shoulders medium, hams deep and thick. Legs fairly short, bone good. Color black with white stripe in face; white feet and tail.

This breed is probably better adapted to the milder climates. Their maturing qualities are not of first rank. They are good grazers and good feeders and fair breeders.

CHESTER WHITE

The name of this breed is indicative of their origin in Chester County, Pa. The designation of the type for the Chester White hog had its origin about 1872. There seems to have been two or more variations in the development of this breed, and at the present time the Ohio improved Chester White is more commonly understood as the type of this breed of hogs. There have been three distinct record books for this group of white hogs, and if the animals have the proper line breeding they are eligible to register in any one of the three record books.

The characteristics of the Chester White swine, according to the official score card of the Chester White Record Association are briefly as follows:

Head short and wide, cheeks neat, jaws broad and strong, head medium high and wide. Face short and smooth, nose neat, slightly dished and tapering. Eyes large, clear and free from wrinkles or overhanging fat. Ears drooping, the tip thin and soft, pointing outward and forward and properly proportioned to the size of the body. The neck should be wide, deep, short, properly arched and tapering from the shoulders. Jowl smooth, neat, firm and tapering. Shoulders broad, deep and full, extending in line with the side and downward to the belly. The thorax should be large, wide, deep and full. There should be an even underline to the shoulders with the

side, with no creases. The ribs should be well sprung, thus providing ample room for the thoracic viscera. Brisket should be smooth, even and broad and wide between the legs. The back should be broad, straight, or only slightly arched, and of uniform width and free from rolls, and the animal should be the same height at the shoulders and at the ham. The sides should be full, smooth, deep. The ribs should be long and well sprung at top and bottom, giving the animal a square form. The belly should be the same width as the back which should be full, straight, the same height at the flank as at the chest. The flanks should be of equal size to the thorax; the head should be broad, long, full, wide and deep. The rump should be slightly rounding from the loin to the root of the tail, and of the same width as the back. The legs should be of medium length, strong, straight, set well apart and well under the body. The bones should be of good size, firm, well muscled, wide above the knees and hock, round and tapering below the hock, thus enabling the animal to carry itself with ease. The pasterns should be short and nearly upright. The feet should be short and firm and the animal should stand well upon the toes. The tail should be smooth, and tapering, carried in a curl. The coat should be fine and preferably straight, evenly distributed and covering the body well. The color should be white. The animals should be large for their age. They should have good action, high carriage, they should be gentle and easily handled.

The Chester White as a feeder ranks high. This breed is generally prolific, but feeders claim that the cross-bred Chester White makes a superior feeder. Chester White pork has been regarded as good by expert meat testers. These hogs are readily adapted to pasture and are desirable feeders and therefore splendid hogs for the corn belt section.

MULE-FOOT

This breed is so named because of its having a solid hoof. The representatives of this breed are not very numerous. This is probably one of the original types of swine but unfortunately until recently about the only constant characteristic of the breed was the solid hoof. A few breeders have been doing some splendid work in establishing this breed by fixing a definite type with distinctive characteristics. It is probable that there are about 12,000 registered

mule-foot hogs, but there will, no doubt, be a rapid increase in the registration of this breed.

Characteristics.—Head medium length. Face almost straight, wide space between the eyes. Eyes bright, free from surrounding wrinkles. Ears medium in length, thin at tips, inclined outward and forward. Neck short and tapering from shoulders. Shoulders deep, medium width, and not extending above line of back. Chest voluminous and roomy but on a line even with belly. Back straight or slightly arched, good width and uniform thickness. Loin full and uniform. Sides full, smooth and uniform from shoulders to ham. Ribs well sprung and strong. Belly straight. Flank full and almost even with side. Hams full, long and deep. Legs well muscled, set evenly, and of medium length. Foot solid, hoof short and smooth. Tail straight or slightly curled and of medium length. Coat fine and smooth. Color, solid black.

This breed is adaptable to any section of the country. They are splendid feeders with early maturity. The sows are prolific, some breeders claiming an average of nine pigs to the litter. They are docile and easily handled.

Other breeds of lard hogs may be discussed, such as the Cheshire, the Victoria, Essex, Yorkshire and Suffolk, but these breeds of hogs are not well established in this country, although they may possess characteristics that are equal to any of the other breeds that have been more definitely described.

BACON HOGS

Export trade demands the bacon type of hogs and pork. However, home consumption of the bacon hog is becoming much more common than in previous years. Generally speaking bacon hogs should have a relatively narrow back, head rather elongated, the sides long and deep, shoulders smooth, legs longer than in the lard type. The flesh contains less fat and more lean than the flesh of the lard type of hogs. Bacon hogs, because of these characteristics, are usually more active than the lard type. They rarely attain a weight of more than 200 or 225 pounds.

HAMPSHIRE

This breed was designated in this country for many years as the thin-rined hog. In 1904 the name was changed to Hampshire and although a different type of hog has the same name in England, it

appears as though this breed in this country will be permanently known as the Hampshire hog. The origin of the American Hampshire is not definitely known. From the history, it is apparent that the first type of hog of this character was developed in Massachusetts about 1820. The following is a description of the characteristics of the Hampshire hog, according to the Hampshire Swine Record Association.

Characteristics.—The head is of medium length, narrow back, not full; the face should be nearly straight and of medium width between the eyes. The eyes should be bright and free from wrinkles or overhanging fat. Ears medium in length, thin, slightly inclined outward and forward. Neck short, well set on shoulders and uniform, tapering from shoulders to head. The jowl should be light and tapering. Shoulders deep, medium wide and full and well in line with the back. The thorax large, deep and roomy, full girth and extending down in line with the belly. The back should be straight or slightly arched, nearly uniform from shoulders to ham and full at the loins. These hogs may be higher at the hip than at the shoulders. The sides should be somewhat full and firm. The ribs should be strong and well sprung. The belly should be straight and full, and running nearly on a line with the sides. The hams should be of medium width, long and deep, rump slightly rounded from loin to root of tail. The legs should be of medium length, set well apart but under the body. They should be wide above the knee and hock and well handled. The bones should be medium and the pastern short and nearly upright, the toes short and firm. Tail should be medium in length and slightly curled. The coat should be black with the exception of the white belt encircling the body, including the four legs, and the hair should be fine, straight and smooth. These animals should be active, vigorous and quick and possess a graceful style. They should be docile, quiet and easily handled.

The Hampshire is usually quite prolific. It is not unusual to find ten to fifteen pigs in a litter, and the sows make excellent mothers and nurses. This breed of hog has been found to be a splendid grazer in Kentucky and in other states where it has been given a trial. This is a characteristic that makes this a popular breed. The quality of meat of the Hampshire, is distinctly superior, particularly the bacon. The breed is not as extensively distributed as some others, but is constantly increasing in popularity.

TAMWORTH

The Tamworth swine originated in central England. The specific origin, however, is not known. The original Tamworth hog was, according to history, very similar in many respects to the American "razor back." As agriculture became intensified the Tamworth was improved and is now one of the choice bacon types of hogs. These hogs were imported into the United States about 1880.

Characteristics.—The Tamworth has a long head, body and legs; the snout is particularly long and has a tendency to be narrow and straight. The face is slightly dished. The ears should be large and erect. The back is narrow and long and usually slightly arched. The sides should be long and deep; the shoulders are well placed; the hams are relatively thin; the legs are long and stand easily upon the toes. The color is red—a golden red hair on a flesh-covered skin free from black preferred.

The Tamworth is relatively large. The average mature boar weighs 600 pounds or more, and sows weigh about 450 pounds. The Tamworth breed ranks high as a bacon hog. The sides are long and have a special mixture of lean and fat. The feeding quality is fairly good. They are good grazers, although many feeders claim that cross-breed Tamworths are superior. The Tamworth is prolific, excelling the Hampshire breed in this particular.

THE LARGE YORKSHIRE

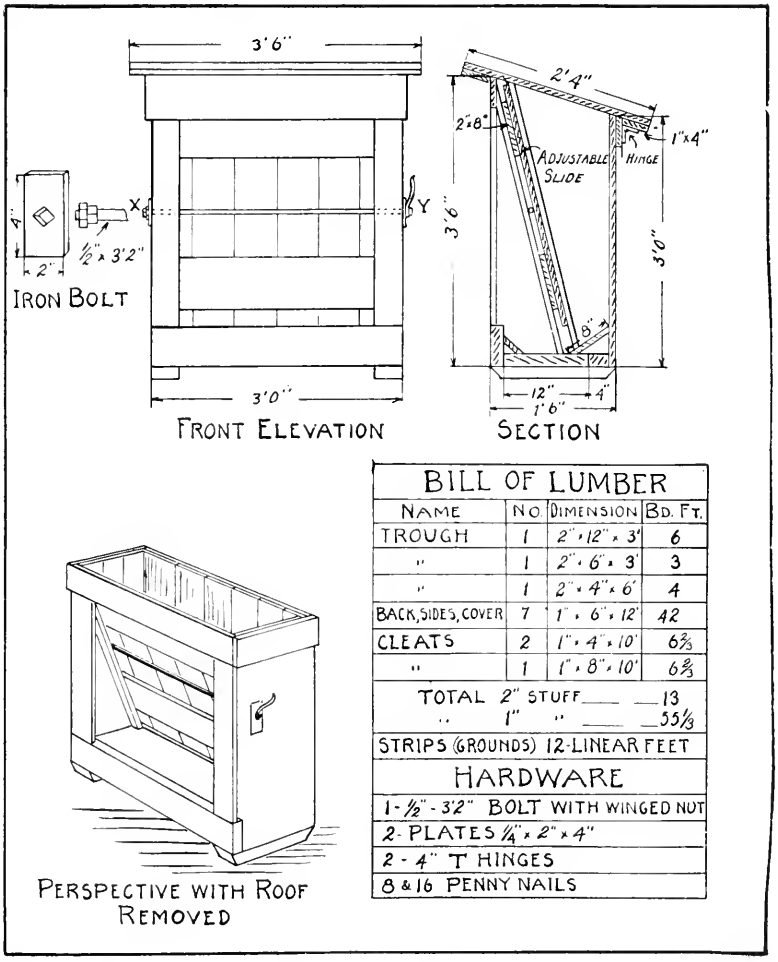
The large Yorkshire is a breed of swine of English origin. It is not very common in the United States, but is a favorite breed in Canada, England, Ireland and some other countries where the raising of swine for bacon is an important industry.

Characteristic.—In general the conformation is typical of the bacon type of hog. Head medium in length with slight dishing of face. Ears heavy and nearly erect, inclining slightly forward. Body distinctly long. Back of uniform width. Shoulder relatively long. Ham large and smooth. Side long, deep and uniform. Ribs well arched. Tail medium with slight curl. Hair long and medium fine. Color white.

This breed is distinguished by their great length and size at maturity. The sows are prolific. They are classed as good feeders in the United States. They are the preferred breed of bacon hog in some foreign countries.

Feeds and Feeding

A food has been defined as any substance which may serve nutritive purposes. The natural demand for nutritive substances depends upon the waste. For maintenance certain elements or food



BILL OF LUMBER

NAME	NO.	DIMENSION	BD. FT.
TROUGH	1	2" x 12" x 3'	6
"	1	2" x 6" x 3'	3
"	1	2" x 4" x 6'	4
BACK, SIDES, COVER	7	1" x 6" x 12'	42
CLEATS	2	1" x 4" x 10'	6⅔
"	1	1" x 8" x 10'	6⅔
TOTAL 2" STUFF			13
" 1" "			55⅓
STRIPS (GROUNDS) 12 LINEAR FEET			

HARDWARE

1-½"-3'2" BOLT WITH WINGED NUT
2-PLATES ¼" x 2" x 4"
2-4" T HINGES
8 & 16 PENNY NAILS

Fig. 5. Small one-way self-feeders. (Cir. 119, Col. of Agri., U. of Wis.)

compounds are required; therfore the elements consumed not only require a certain quantity but must have a definite quality. A complete ration contains both organic and inorganic substances. The organic foods are nitrogenous and non-nitrogenous. Nitrogenous

foods are used in repair and growth. Non-nitrogenous foods, which are largely carbohydrates and fats, are the source of energy and the portion not consumed in energy products is stored as fat. Inorganic foods are necessary to replace the same elements that are found in various tissues and removed in secretions and excretions. Water and various mineral salts are the usual inorganic foods.

Diet depends upon the type of animal and its use. Mothers' milk is the natural diet of new born mammals. By a series of

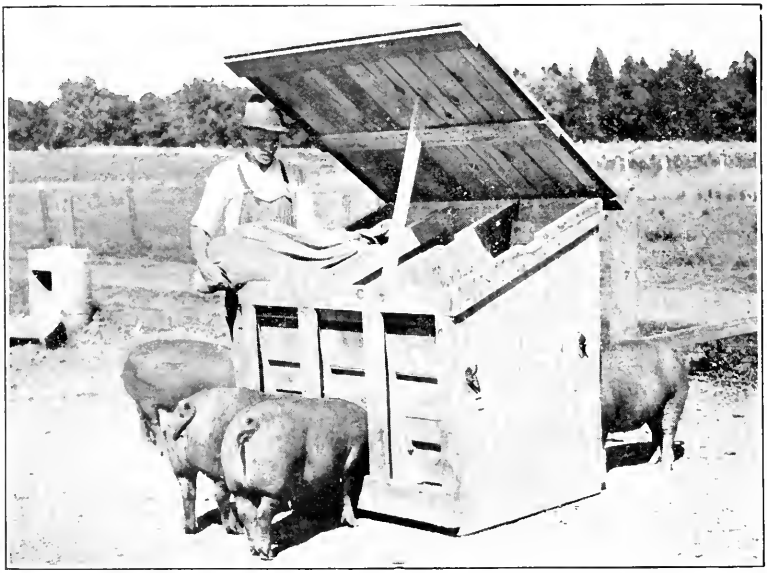


Fig. 6. This "Cafeteria" is open twenty-four hours of the day. Pigs choose what they want, as often as they want, and as much as they want. The curl in their tails "registers" perfect contentment. (Cir. 119, Col. Agri., U. of Wis.)

experiments conducted at the Wisconsin Station, it was found that sows produced on an average of from 4.9 to 6.3 lbs. of milk for a series of 84 days. There is a wide variation in the quantity and perhaps also in the quality of sow's milk. Analysis of milk from a limited number of sows, shows that it contains approximately 7 per cent butterfat, 6 per cent casein and albumin, 5.7 per cent sugar and 1 per cent of ash, or total solids of over 19 per cent. The total solids of cow's milk rarely exceeds 13 per cent. The fat

globules of sow's milk are only one-fourth as large as those of cow's milk, which renders sow's milk more readily digestible than cow's milk. On investigation, Wall found that a mature sow produces 7 7 10 lbs. of milk in twenty-four hours on a ration composed of 4 lbs. each of corn meal and wheat middlings and 8 lbs. of skim milk. The sow's ability to convert feed into milk ranks favorably with that of a good dairy cow.

Pigs when farrowed weigh from $1\frac{1}{2}$ to 3 lbs. each. Those from mature sows are usually larger than those from gilts. There is constant-

Fig. 7. Pigs getting their rations at a self-feeder. (Cir. 119, Col. of Agri., U. of Wis.)

ly increasing gain in weight when proper conditions are provided for pigs from the time of farrowing until weaning. The average weight of pigs at weaning time is from 35 to 50 lbs. This development in suckling pigs depends not only upon the supply of mother's milk, but also upon other foods.

About 1 per cent of the weight of the sow is required in concentrated foods to support her and a litter of pigs during the first

ten days after farrowing. Of that quantity about one-third is required for the maintenance of the sow and two-thirds for the production of milk.

The preparation of food stuff for swine is worthy of consideration. It has been found that grinding corn effected a saving in the majority of tests, sufficient to more than pay for the grinding; thus making grinding an economical proposition for the feeder. It is probable that corn, oats or like products should not be cooked. Potatoes and some other allied products are probably more palatable and, consequently, make better feed when cooked. The value of soaking feed has been another disputed question. It is doubtful whether soaked feed has any superior quality to the original dry feed, and there are many objections to the soaking of feed. Therefore, in a general way, it may be said that it is not practical to soak feed for swine.

The method of feeding is attracting considerable attention at the present time and recently there has been perfected a variety of self-feeders for hogs. These appliances are in demand because they diminish the cost of production in that they save labor, time and feed. Just the style of self-feeder that should be selected depends entirely upon circumstances and the purpose for which it is designed. Self-feeders are available in which any known kind of food stuff can be used. Some self-feeders are so constructed that the different food ingredients can be mixed. In others these various foods can be kept separate. Self-feeders should be cheap, durable, roomy, easily regulated for different kinds of feed and so constructed that there will be little difficulty from clogging of the trough. Feeders that have installed self-feeders have found that it is necessary to keep a close watch to see that the feeder does not become clogged and to see that it is properly located and always contains feed. When self-feeders are to supply feed for hogs that are on pasture they should be placed near to the pasture, or better, within the pasture; otherwise, the hogs will do little grazing.

FEEDING REQUIRES CARE AND JUDGMENT

The feeding of swine requires care and judgment. Good results are obtained if the feeder regulates the amount of feed and the methods of feeding. For full feeding the feed should be increased gradually. Swine that have been simultaneously immunized against cholera should be given not more than half of their accustomed

ration for a period of one week. In case of necrotic enteritis, tankage and like foods should be diminished, or withheld. Brood sows should be given ground oats or barley when their pigs are affected with scour.

The following are important hog feeds:

Fat and carbohydrate concentrates: corn, kafir, milo, feterita, wheat, oats, barley, rye, speltz, and rice. Various modifications and forms of the above named feeds are on the market. Corn is perhaps the most common hog feed in the central states. It may be fed as ear corn, shelled corn, corn meal, corn and cob meal, hominy and recently it has been found to be profitable to hog-down corn. Kafir appears to have about 90 per cent of the feeding value of corn. This grain is produced in some of the semi-arid sections and is a very popular feed. Milo and feterita are very similar to kafir and need no further discussion. Wheat, particularly when ground, is a splendid hog feed, although it usually is prohibitive because of its price. Oats is an especially valuable feed, particularly for sows and little pigs and should be ground before being used as feed for swine. When used for little pigs, it is advisable to remove the hulls as they are likely to cause impaction. Barley is a fairly good substitute for oats as a hog feed and like oats should be ground before being fed. Rye, speltz and rice have practically the same value as wheat as to hog feeds. They should be ground but are rarely used because of their high cost.

Protein concentrates: skim milk, buttermilk, whey, tankage, meat meal, blood meal, oil meal, shorts, bran, commercial stock feeds, cotton seed meal, alfalfa meal, peas, beans and peanuts. Skim milk is one of the best and cheapest protein feeds for swine. It is particularly valuable for young pigs and brood sows. When mixed with shorts or middlings, it makes a wonderful protein supplement to be combined with corn. For every pound of corn, not more than 3 lbs. of skim milk should be fed to swine to secure the best and most economical results. Feeding on this basis when corn is $1.00 per bushel, skim milk has a value of over 50c for each 100 lbs. Butter milk is of equal value to skim milk for pig feeding. Whey has been found to be worth about one-half as much as skim milk for pig-feeding purposes. A condensed form of skim milk and probably other milk by-products are now manufactured, and reports indicate that these products are valuable as food for swine. Tankage or meat meal is a splendid supplement to corn as the tankage sup-

plies the protein, the percentage varying from one to twenty per cent of tankage, depending upon the age of the hog and whether or not he is on a maintenance ration or is to be fattened. Blood meal should be fed in a smaller proportion than meat meal, as it is more concentrated.

Oil meal is a splendid nitrogenous feed for swine. It contains only about one-half as much digestible protein as tankage and therefore must be fed in larger quantities. This feed is especially valuable as a conditioner and a laxative, and is fed by a great many breeders to sows just before farrowing. Shorts combined with corn meal make a splendid ration for swine. Their value is probably indicated by the fact that about 90 per cent of hog feeders use shorts. Bran is a laxative and when properly combined with shorts is a valuable feed. It contains muscle and bone-forming elements but does not contain as high a percentage of nitrogen as some of the foregoing feeds. There is such a variety of commercial stock feeds designed for the purpose of fattening that a detailed description of them does not seem advisable in a text of this character. Cotton-seed meal is fed in considerable quantities in some sections of the country. There is, however, danger in the use of this feed and it should be used guardedly by feeders; otherwise, bad results are likely to follow. Alfalfa meal is a splendid food. It is rather bulky and highly nitrogenous and should be combined with some of the concentrated protein feeds, when used. Peas, beans and peanuts are all valuable nitrogenous foods. The specific combination that gives best results will depend upon the type of pea or bean, but they will be found in practically all instances to be highly nitrogenous.

It has been found profitable in practically every community to pasture hogs for a portion of the year. From all reports, it seems probable that alfalfa pasture is the most desirable, but unfortunately it can not be grown in some sections. Not only is alfalfa pasture of value in the growing of swine, but also alfalfa hay is found to be of almost equal value, particularly if the alfalfa is cut at the proper time. Red clover is almost as valuable as alfalfa and is preferred in many locations because of the ease with which it is cultivated. By test it has been found that one acre of red clover pasture is worth as much as a ton of shorts.

A few breeders are now resorting to sweet clover as a substitute for alfalfa or for red clover. Rape is sometimes used for pasture,

and according to some authorities is superior to clover. Blue grass is used for pasture by some breeders. During certain seasons of the year many breeders have found it profitable to use wheat, rye or oats as a pasture grass. The pasture regardless of the grass or forage contained should neither be too large nor too small, especially for fattening or growing swine, although it is not objectionable to have a large area for brood sows. Swine in pasture usually require ringing to prevent rooting. In some portions of the country, roots of various kinds are grown for feed purposes and serve admirably as a bulk feed. For this purpose, sugar beets, turnips, mangels and carrots are used for hog feed in different sections of the country. Pumpkins, squash, apples and potatoes are used to some extent in some localities for swine feed.

GARBAGE FEEDING

Garbage feeding of swine is now done on a large scale adjacent to the larger cities in all parts of this country. It was recommended by the government as a means of conservation, and garbage feeding was instituted near practically every large camp in this country during the recent war. As the population increases there will of necessity be greater need for the conservation and conversion into food, of materials that are now wasted. Swine can complete the cycle between man's waste and his food, and from a sanitary point of view pork from garbage-fed hogs is not injurious and is a wholesome food.

Garbage when not contaminated with foreign substances, such as broken glass, lye, paint, varnish, etc., is not injurious to swine. The feeding should be done on especially constructed platforms, preferably of concrete. These platforms should be thoroughly cleaned at least once daily in warm weather, to prevent putrefaction products from accumulating, and also for sanitary reasons. In the beginning swine should be fed sparingly of garbage until they become accustomed to it. The quantity fed must be determined by the nature of the garbage, but it should not be piled into the troughs in excess of what will be consumed each day. Garbage-fed hogs, when shipped, will shrink more in proportion than those fed on grains.

Sanitation

The ordinary hog feeders do not appear to recognize the value of good sanitation in their feed lots and shelter houses, and many

pure-bred breeders do not provide sanitary conditions that are necessary to the maintenance of the health of their swine. Some veterinarians apparently do not realize the necessity for sanitary surroundings for successful swine breeding or feeding. "Anything is good enough for swine," is an altogether too common maxim and too frequently followed.

The original wild hog is select in habits particularly as to its bed and place for farrowing. Domesticated swine have been kept in filth for so many generations that it is presumed by many that insanitary surroundings are required for swine.

The prime sanitary requisites for successful swine breeding and feeding are: 1, housing; 2, properly drained lots; 3, equipment that can be effectively cleaned; 4, feed and water; 5, quarantine.

The provision for shelter for swine is necessary, because nature did not provide them with a coat of hair sufficient to protect them against extreme weather conditions or sudden changes in tempera-

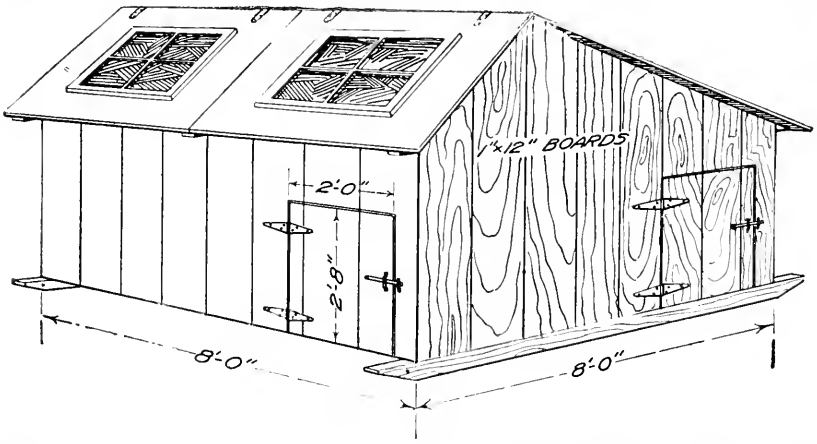


Fig. 8. Box-type movable hog house, closed. (Cir. 102, U. S. Dept. Agri.)

ture. Their thin coat of bristles is insufficient protection, particularly in little pigs, to insure health. In the construction of hog houses the following points should be given consideration: location, adaptability for the purpose desired, light, ventilation and convenience. The material for construction of hog houses necessarily varies somewhat in different localities. The usual hog house, at least the super-structure, is made of lumber. The old straw sheds,

although occasionally seen are to be condemned, as they are invariably insanitary. Stone, brick and tile are used in the building of hog houses and when properly constructed, houses of these materials are desirable. The kind of floor for hog houses has been discussed in various periodicals for several years, and apparently the decision has been that concrete is desirable if some cover is provided that overcomes the dampness and cold, peculiarities characteristic of concrete in cold weather. Some obtain results from a plank floor over the concrete, others use a cork brick, and some swine breeders in the extreme south are claiming good success with out a cover of any kind on the concrete, but they use extra quantities of bedding. The essential condition required is that the floor be practically impervious so that it can be cleaned and properly drained.

THE HOG HOUSE

The location of a hog house is a problem that can be determined only by a careful study of the arrangements of the other farm build-

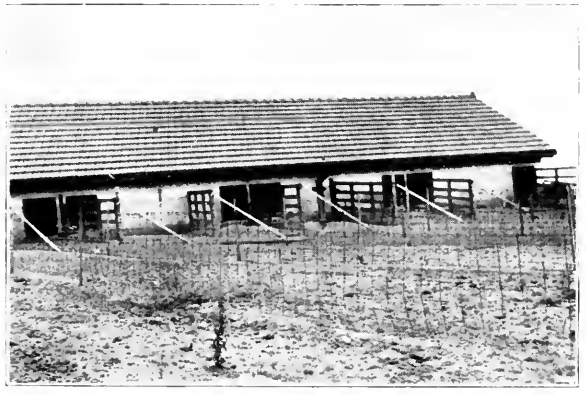


Fig. 9. Expensive hog house and yards. A permanent location such as this increases the difficulty of combating disease and parasites.

ings. The hog house should be conveniently located as to supply of feed and water. The location should be such as to provide for good drainage and so situated that it will not receive the drainage from the horse or cattle barns or yards. It is advisable to build only upon soil that is more or less porous. The direction of the long axis of the hog house will depend upon the location and the form

of the house. The double hog house with a center hall should extend east and west and have a northern and southern exposure. However, the north outside pens of such a house are of little value for little pigs in the winter. Houses in which the pens are on the one side only should, of course, extend east and west and thus have a southern exposure.

The type of hog house will depend upon the requirements. Farrowing houses of the double type with a center hall and a series of pens

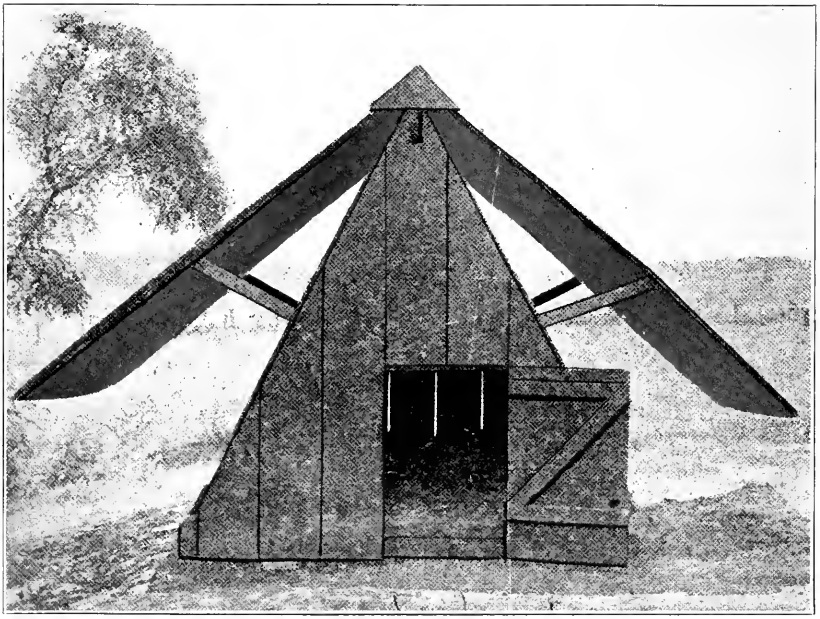


Fig. 10. Mississippi hog house. This type of house provides comfort for hogs both in winter and summer. (Bull. 177, Miss. Agri. Ex. Sta.)

on either side are the most economically constructed per pen and are rather popular in some sections of the country. Some breeders of high-priced swine prefer to build a single house with the hall extending along the north wall and one series of pens with a southern exposure. The single house is more desirable because of the southern exposure but is not as economical. The single farrowing house is probably the most popular and apparently the most economical. The type of single farrowing house in most common use is the

simple A form house which is so constructed that it can be readily moved by a horse or team of horses. Every farrowing pen should be provided with a pig rail about eight inches above the floor and the same distance from the sides. This protects pigs from crushing by careless mothers.

Houses or shelter for feeding hogs should be simple in type, the rectangular form being the most economical. These sheds or houses should have a southern exposure. They serve also as a windbreak on the north side of the hog lot. It is not advisable to have such sheds too large, or if they are of such size that they shelter more than one carload of fattening hogs there should be partitions or partition fences to keep the hogs separated into lots of not more than 80 to 100 head each.

VENTILATION NECESSARY

That the subject of ventilation has not been given proper consideration by the builders of hog houses is evident to those who have inspected hog houses in practically any section of the country: Proper ventilation is especially necessary in farrowing houses. Little pigs are delicate and are very susceptible to the action of draughts, and the successful breeder has the hog house so constructed that the recently farrowed pigs will be kept dry and warm, away from draughts and amply provided with fresh air. Improper ventilation is responsible for the loss of hundreds of pigs annually. In a well ventilated hog house, the walls and windows will remain practically dry even in cold weather. In the construction of a double hog house with a center hall or a single hog house with a series of pens on one side only, it is advisable to make an offset in the roof as this provides a means for proper ventilation. A second row of windows should be provided in each side of the hog house, the bottom of the window being about three and one-half feet above the floor and hinged at the bottom so they can be lowered from the top. In the individual hog house hinged windows should be placed at the ends and a ventilator above. Improved methods of ventilation by special appliances are worthy of consideration.

The subject of lighting is effected in conjunction with ventilation except when special ventilating devices are installed. A hog house for farrowing purposes cannot be over-lighted in the colder sections of the country. Window glass through which the sun can shine is a means of purification, and of increasing the warmth. In con-

structing the double hog house with the center hall or one half of the double house, offsets in the roof should be provided in order that all parts of each pen will be amply lighted. A second row of windows should be provided on each side, of either a single or double hog house, the bottom of the window being about three and one-half feet above the floor. The single farrowing house may be constructed with windows on two sides or with hinged board shutters which may be opened except during stormy weather and thus ample light be provided.

No special expense is required in the construction of hog houses to make them convenient for the caretaker and thus save labor and inconvenience. The partitions should be made of sections that can be removed and used in making new combinations of pens, alleys or chutes. Troughs for water and feed can be placed where they are readily accessible to the feeder and so arranged that they can be easily and effectively cleaned. The feed bins can be made hopper fashion in order that the feed may be accurately measured and easily obtained. The floors can be so laid that they can be cleaned with little labor, and space that is accessible should be provided for the accumulation of manure and other waste. Water should also be convenient. When possible, running water is most desirable, but this can be provided with safety only in heated hog houses in most sections of the country.

For fattening hogs, it is quite essential to have a solid floor where feeding and watering is done. These floors should be made of concrete, although heavy plank will do. Such floors should be provided regardless of the size of the lot or pasture in which the hogs are kept. Feeding and watering troughs or self feeders should be so placed on these floors or platforms that food or water that is spilled will be accumulated on them. The self feeder will be found convenient and will save feed and labor and therefore be economical for fattening of hogs as well as for the maintenance of breeding hogs.

A dipping vat should be provided on every farm on which hogs are kept. It should be so located that the surface drainage can be controlled and so that the arrangement of the pens and chutes will be convenient. The kind of a dipping vat installed will depend upon the permanency of the location of the vat and the cost price. Galvanized iron vats are easily placed in position and can be readi-

ly moved to other locations. Concrete vats are practically permanent as to location.

A vat should be of the following dimensions:

Top length ....10 ft. 8 in.	Top width .....2 ft. 4 in.
Bottom length 4 ft. 8 in	Bottom width ..1 ft. 6 in.
	Depth .....4 ft. 4 in.

There should be an incline on both the inlet and outlet ends. The dripping pen should be about 5 ft. square and the floor so arranged that the drip from the animals will drain back into the vat.

PROPER DRAINAGE ESSENTIAL

The location of hog yards and lots so as to insure proper drainage is frequently overlooked. On many farms the hog lot is located

Fig. 11. Well-drained swine pastures where but few animals are kept together. There is little trouble from disease and parasitism where such methods are followed.

on ground that is low, boggy or swampy and is apparently of no value for any other purpose. The selection of such lots is a serious mistake and is frequently responsible for the failure to produce hogs at a profit on that farm. Hog lots should be high and dry and so located as to insure good drainage. The old hog wallow serves no good purpose but does provide a ready means for the propagation of a variety of infective agents and serves to promote the maintenance of animal parasites on the premises. Low areas should be overcome by grading, thus preventing the accumulation of stagnant water. Pasturing is the preferable way of maintaining hogs from the sanitary viewpoint.

All equipment used in the handling of swine, such as water troughs, feed troughs, self-feeders, chutes, dipping vats and crates should be so constructed that they can be efficiently cleaned. The successful breeder and feeder has found that the handling of swine for profit can be accomplished only when all equipment houses, pens and lots are kept in a sanitary condition. It is also found that those who lose money in handling hogs usually do so because of their failure to recognize the importance of sanitation.

Clean wholesome water is as requisite to the health of swine as it is to the health of any other animal. Hogs that obtain and depend upon water from stagnant pools or ponds are practically always found to harbor large numbers of animal parasites. It is probable the digestive disturbances, such as infections necrotic enteritis, are more prevalent in swine that obtain their water from questionable sources than in swine that are provided with clean wholesome water.

VALUE OF QUARANTINE

Every well regulated swine-breeding or feeding farm has provisions for quarantining newly purchased animals, show animals or sick animals that may be in the home herd. Quarantine is efficient only when the animals are absolutely isolated from all others and exposure of all other animals prevented. Quarantine pens should therefore be removed some distance from the regular pens. Newly introduced animals or show herds should be kept in absolute quarantine for a period of at least three weeks, and then if they appear normal they may be permitted in the general hog houses or lots. Sick animals should be isolated for a sufficient time to determine the existing condition, and if they are found to be affected with some infectious disease the quarantine should be continued for three weeks after they have apparently recovered. The quarantine pens should be cleaned and disinfected after use, regardless of whether the quarantined animal evidenced disease or not. Cleaning should consist of gathering all manure, bedding and other litter and burning or thoroughly soaking with a 3 per cent solution of liquor cresolis compositus; then all fences, partitions, feed troughs and the interior of the quarantine hog house should be thoroughly washed with the same solution.

General Diagnosis

Diagnosis is the foundation for successful treatment. There has been considerable confusion in the diagnosis of swine diseases. This

confusion in the identification of diseases of swine by practitioners has been largely due to the publication of contradictory statements. Some practitioners diagnose practically all ailments of swine as cholera regardless of evidence that would in some cases clearly indicate some other disease. In some sections practically all diseases of hogs are designated as "mixed infection," and in other localities, according to reports, swine are always afflicted with "flu."

The differential diagnosis of diseases of swine requires a comprehensive investigation including postmortem examinations. The examination of sick hogs as made by the general practitioner is usually entirely too superficial for a differential diagnosis. It is true that the diagnosis made by the practitioner is correct in the majority of instances, but an erroneous diagnosis will stand out prominently in a community and will have a tendency to cause a lack of confidence by the hog raisers in the veterinarian. The practitioner should educate his clientele as to the value of laboratory examination, which is frequently necessary in making a positive diagnosis. Judgment must be exercised in all cases and in many instances it may be advisable to apply treatment before an absolute diagnosis has been made.

A comprehension of the structure and functions of the various parts of the body is indispensable. In other words, the successful practitioner should possess a knowledge of anatomy and physiology and the fundamental principles of pathology and bacteriology, as well as a knowledge of therapeutics. Too many students in veterinary colleges and some practitioners are of the opinion that their success in practice will be measured by their knowledge of drugs, serums, etc. The student and the practitioner should not obtain less information upon therapeutics, but should obtain more information upon the basic subjects of anatomy, physiology, pathology, bacteriology and chemistry, if they expect to render the service to the live stock industry that is justifiable.

In making an investigation of hogs for the purpose of diagnosis, the veterinarian should be very deliberate. He can profitably sit on the fence while he views the affected animals undisturbed, noting their attitude and general behavior. After all information that is possible has been obtained from "the seat on the fence," the veterinarian should walk leisurely around in the pen observing the general movement of the swine, noting whether any symptoms are evident

and incidentally observing the character of the feces, the nature of the feed, condition of housing and general sanitation.

HISTORY OF PARAMOUNT IMPORTANCE

During the time that the foregoing general inspection is being made, or immediately thereafter, the history of the affected animal or animals should be obtained. Each veterinarian has, no doubt, acquired a method of obtaining information from his client.

The exact history of diseased conditions in swine is of paramount importance, particularly in differentiating between infectious diseases. It is always essential to determine whether or not the swine in question have been medicated or whether they have been immunized against hog cholera, swine plague or other infections and the time of immunization. It is conceded that the simultaneous immunization of swine against hog cholera will produce lesions that are usually attributed to hog cholera and if such immunization has been done recently and the attending veterinarian fail to obtain that information, he would probably diagnose any existing condition as hog cholera from the autopsy findings in such animals. The history of the case should include the length of time that the disease has existed, the symptoms evidenced, the nature of the feed, the number of animals affected and their age, because these are all questions of vital importance in the diagnosis of swine diseases.

After the history of the case has been ascertained a careful examination of the diseased animal should be made to determine the present condition. This examination should include a careful inspection of every region of the body, manipulation of all available parts of the body, especially any portion that is apparently abnormal. Allowance must be made for nervous, irritable animals. Examination by percussion and auscultation is of less value in swine than in most other animals; however, by experience, particularly in bacon hogs, a fairly accurate examination can be made of the thoracic viscera.

ATTITUDE OF ANIMAL

The general attitude of the diseased animal is significant and sometimes is of value in making a diagnosis. Swine affected with pneumonia are usually found lying down, except when the lung capacity is seriously diminished, when they will assume a sitting posture. Un-

certain gait characterizes general weakness and is typified in the latter stages of any infective disease or debilitating condition. Stilty gait is characteristic of tetanus in swine. Dragging of the hind quarters is typical of rachitis, polyneuritis, osseous tuberculosis and perhaps some other conditions. Lameness associated with swollen joints is typical of polyarthritis. Disturbances of locomotion may be of rheumatic origin or may be due to injury, or to infection with B. necrophorus.

CONGESTION OF THE SKIN

Congestion or hemorrhage into the skin is observed in hog cholera, paratyphoid infection and swine plague, and there is a peculiarly disposed congestion in the so-called diamond skin disease in which the congested area occurs in the form of a baseball diamond. Malignant edema has been identified in swine and is typified by a subcutaneous edema with deep-seated gas. Swine are subject to urticaria in which the lesions are typical but are usually difficult to identify because of the cutaneous pigment, excepting in those cases which are well marked. There is a papulo-vesicular eruptive condition that occurs in swine in the south in which the successive changes are papules, vesicles and in some cases pustules, followed by scab formation or less frequently by ulceration.

ECZEMA

Eczema with all the cutaneous variable symptoms and lesions is occasionally observed in swine. Swine are affected with sarcoptic and follicular mange, the cutaneous lesions of which are characteristic. In sarcoptic mange the lesions are first noted around the eyes and ears and consist of papules, vesicles and pustules. The principal symptom of sarcoptic mange is intense pruritus. This condition usually affects several animals in the same lot. Follicular mange is usually not of an enzootic character. The lesions are usually confined to the skin of the legs which will be intensely red. Cutaneous irritation due to infestation with lice, fleas and mosquitoes should not be overlooked. Foot-and-mouth disease affects swine in which the typical changes incident to that disease are observed.

There is usually a mucopurulent inflammation of the conjunctival mucosa in hog cholera and swine plague, and a similar condition has been observed as a result of the bites of flies and gnats. There may

be a specific conjunctivitis in swine, in which there is a mucopurulent discharge.

TEMPERATURE VARIATIONS

The normal temperature of mature swine is about 102° F. and of pigs from 102° to 104° F. The temperature of swine is readily obtained by inserting a clinical thermometer into the rectum. When it is necessary to ascertain the temperature of a large number of swine it will be found advantageous to provide a small pen in which the operator can readily take temperatures without exciting the swine. This method is used in public stockyards where immunizing against hog cholera is done on a large scale. Where more than one thermometer is used by a single operator it will be found advantageous to attach a string with some kind of a clamp to the thermometer. The thermometer can then be inserted and fastened to the pigs' hair.

Typical remittent or intermittent fever has not been recorded in swine in this country. In the infective diseases of swine there is a regular, continuous fever. Hogs are especially subject to high temperatures, particularly those of the lard type. Hog cholera is typified by a regular fever in which the high point may be 108° F. Swine plague is associated with fever, the temperature in which is usually not so high as in hog cholera.

The fact that excitement and exertion cause a rise of temperature in swine must not be lost sight of by the examining veterinarian. Necrotic or infective enteritis is associated with an irregular fever in which the temperature may reach 105° F. Subnormal temperature is frequently observed in the later stages of hog cholera and necrotic enteritis. Anthrax is an acute infective disease characterized by a continuous fever in which the temperature is relatively high.

EXAMINATION OF HEART AND PULSE RATE

The usual method of determining the rate of the heart is by feeling the pulsations as transferred in an artery. In swine it is extremely difficult to detect the pulse in the usual manner; hence the heart-beat is taken. The average pulse-frequency or heart-beat in swine varies from 60 to 100 per minute. As in other animals, the larger individuals carry a slower pulse-rate. The pulse-rate is increased by excitement or exercise, in most febrile diseases, in severe hemorrhage and when the animal is suffering from injuries or other conditions that cause pain. Because of our inability to de-

tect the pulse in swine it is not possible to make determinations relative to the rhythm and quality of the pulse. Swine are apparently not as subject to disturbances of the heart and blood vessels as other animals.

DISEASES OF RESPIRATORY ORGANS

Swine are relatively prone to diseases of the respiratory organs; therefore a careful examination should be made to ascertain, if possible, the condition of those organs. The respiratory rate varies in swine from 10 to 20 per minute. Large and mature swine breathe less frequently than small pigs. Respiration is increased by excitement and exercise and is relatively more frequent in high altitudes. Inspiration may be prolonged by stenosis of the anterior respiratory passages, and expiration may be prolonged by spasms of the bronchioles or inefficiency of the diaphragm. Labored breathing or dyspnea occurs as a result of fever, diseases of the lung, bronchioles, pleura, diaphragm and peritoneum; in pulmonary emphysema and edema. The exhaled air has a bad odor, from swine affected with pulmonary necrobacillosis, and in some cases of medicamentous pneumonia.

NASAL DISCHARGE

Nasal discharge is always pathological in swine. The quantity, color and consistency of the nasal discharge should be carefully noted. The quantity generally indicates the extent of the process; the color and consistency and the nature of the process. If the discharge is admixed with air and appears as a foam it probably originates from the bronchioles and indicates bronchiolitis. Involvement of the nasal mucosa and bulging of the nasal and facial bones occur in bull-nose. In some cases, ulceration and necrosis of the nasal mucosa are observed; they indicate necrobacillosis.

COUGH

Cough, a sudden expiration following a full deep inspiration, is a common symptom occurring in a variety of respiratory diseases. Cough also occurs as a result of inhaled foreign bodies, smoke, dust, cold air, parasites, etc. A short hacking cough indicates disturbances of the pharynx. Laryngeal irritation is evidenced by repeated coughing. In bronchitis there is usually a moist deep cough. Parasitic pneumonia is usually manifested by a series of expulsive ex-

piratory efforts or cough or spasms of coughing and there is usually a wheezing respiration. An examination of the lungs of swine is not practical except to a limited extent in bacon hogs, because of the thickness of the thoracic wall.

NATURE OF FEED AND WATER SHOULD BE DETERMINED

It is always advisable to make a careful examination of the food and water. The quantity and quality of food consumed is of prime importance. Swine frequently consume young cockleburs and become affected with acute gastritis or gastro-enteritis. Inappetence is an outstanding symptom of acute infective diseases and especially hog cholera. The desire for water is increased in diseases in which there is diarrhea and also in febrile conditions.

DIGESTIVE DISTURBANCES

Swine experience little difficulty in deglutition and disturbance of the pharynx and the esophagus are not common. Swine are apparently provided with durable teeth as they seem to have little difficulty in mastication which, however, is usually not thorough. Little pigs occasionally become affected with ulcerative stomatitis in which the buccal mucosa adjacent to the teeth is affected probably as a result of infection with the B. necrophorus.

Because of the anatomical nature of the stomach and esophagus, swine vomit with ease, and this method of relief probably prevents serious digestive disturbances resulting from gorging or overloading the stomach. Vomition is frequently observed in the early stages of hog cholera, also in intestinal obstruction, extreme cases of constipation and when there are foreign bodies in the stomach.

Swine are not as subject to the various digestive disturbances as are larger animals. However, garbage-fed hogs may become affected with digestive disturbances, the result of auto-intoxication or the consumption of putrid protein foods. Constipation is evidence of febrile diseases or excessively dry bulky foods, but it is not of common occurrence.

Diarrhea is the characteristic symptom in pig scour and infective necrotic enteritis. Fecal discharges should be carefully examined for the detection of parasites or their ova. Arduenna strongylina, Ascaris suum, Esophagostoma dentatum, Trichocephalus crenatus, Trichina spiralis and Gigantorynchus hirudinaceus are the para-

sites that may be found in the feces of swine. Diarrhea is also a common symptom of hog cholera.

URO-GENITAL DISTURBANCES

It is difficult to make a physical examination of swine for the detection of disturbances of the urinary organs. It is possible to catheterize sows, but it is practically impossible to perform this operation upon a barrow or boar. Information is limited relative to the findings in the urinalysis in swine. By inspection the frequency of urination or attempts to urinate can be noted. The color, consistency and odor of the urine can usually be determined. Frequent attempts to urinate may indicate irritation of the urogenital organs, calculi in the urinary channels and peritonitis. Blood in the urine is indicative of nephritis, calculi, cystitis or injury of the urethra. If the blood is thoroughly admixed with the urine, the hemorrhage has probably occurred in the kidney. If the blood occurs in the first urine voided the hemorrhages have been in the urethra, and if the blood occurs in the last urine voided and is more or less coagulated, the hemorrhage has probably been in the bladder. The urine will probably be of a dark color in febrile diseases. Urination will be less frequent and there will be less urine voided in anima's affected with diarrhea. Incontinence of urine may be observed in some nervous disorders, particularly in paralysis.

The testicles of boars are readily examined but excepting the external genitals the sexual organs of sows are not easily examined. Unusual sexual desire and irregular periods of estrum are not uncommon in sows that have aborted, and are probably the result of disease of the ovaries, fallopian tubes or uterus. Vaginal discharge is common for from one to three weeks in sows that have aborted. In the beginning the discharges in these cases are of a bloody character but later become purulent.

Inflammation of the udder may occur in sows that are heavy milkers. This condition is caused by incomplete milking out of the udder by the pigs, by injury or by infection. Tubercular and actinomycotic infection of the mammae are relatively common in sows.

NERVOUS DISORDERS

Disturbances of the nervous system of swine have not been extensively investigated. Functional disturbances of the brain are observed in pigs, and are probably most frequently the result of in-

toxication or irritation induced by intestinal parasites. Viciousness in boars is sometimes classed as a disturbance of cerebral function. Epilepsy or a closely allied condition has been observed in swine. This condition is characterized by restlessness, muscular tremors, champing of the teeth, falling and extension and frequent jerking of the legs and head. A condition designated as dentition eclampsia sometimes occurs in pigs and is apparently the result of irritation due to eruption of teeth. Chorea may occur in swine. So-called blind staggers has also been observed in swine.

Swine may be tested for tuberculosis, the intradermal test being the one commonly applied to swine. The tuberculin is injected into the skin of the ear on the posterosuperior surface.

Rabies is not uncommon in swine. The usual disturbances of the nervous system that characterize the disease are observed in these animals.

Autopsy

An autopsy is a systematic examination of the various organs and tissues of a cadaver made for the purpose of determining the cause of death. Autopsy, postmortem and necropsy are synonymous terms and are used interchangeably.

The value of autopsy findings cannot be overestimated. Symptoms of several infective diseases of swine are so similar that it is not possible to make a differential diagnosis without an autopsy. The successful practitioners verify their clinical diagnoses by the lesions evidenced in autopsies. Many practitioners have needlessly immunized hogs against hog cholera, without beneficial results, because the symptoms manifested were similar to the symptoms of hog cholera, but had an autopsy been made a proper diagnosis would have been established and the swine owner saved the expense incurred by immunization. Excepting in extraordinary cases, it is inadvisable to make a positive diagnosis of any infective disease of swine, without the knowledge gained by a careful autopsy. In conducting autopsies, it is advisable to follow some definite plan which will facilitate the work and preserve the knowledge obtained in tangible form.

OBTAIN PERMISSION AND AUTHORITY

Before beginning an autopsy permission should be obtained from the owner of the animal, and one should be certain that there are no laws prohibiting a postmortem examination in such cases.

THE SUBJECT FOR AUTOPSY

Cadavers are usually available for autopsy purposes, particularly when an infective disease exists in a herd of hogs. A cadaver selected for autopsy purposes should have been dead only a very short time. A live animal showing marked symptoms is preferable to a cadaver for autopsy purposes, particularly for the verification of a diagnosis. When a living animal is selected for an autopsy the method of destruction must be such that the lesions will not be materially changed. Most infective diseases are of an inflammatory nature, consequently the lesions contain excessive quantities of blood. If one is desirous of having the lesions in such cases stand out prominently, the animal should not be destroyed by bleeding. There is, however, sufficient blood retained in such lesions that they can readily be indentified even after the animal has been destroyed by bleeding, and unless there is some special reason such cases may be destroyed by bleeding. Cases in which the brain is to be examined should not be destroyed by shooting in the brain or crushing the skull by a blunt object.

In making medico-legal examinations, it is advisable to have witnesses, and when possible organs or parts showing characteristic lesions should be saved.

Postmortem examinations should be made in daylight, excepting in extraordinary cases. The cadaver should be placed so that the operator can perform the autopsy conveniently.

EQUIPMENT

Proper clothing should be provided. Obstetrical rubberoid suits, or suits made of some other similar material, will be found convenient and efficient. The shoes should also be protected or substituted by rubber boots or special apparel. Some prefer to wear rubber gloves and thus protect the hands. All clothing required should be kept in an autopsy case, and should not be used for other purposes.

Innumerable instruments are recommended for an autopsy kit. The instruments selected will necessarily be determined by each individual's preference. Instruments should be selected that are of use and can be sterilized. Two or three knives, one relatively large, a saw or cleaver, some forceps, blunt and sharp-pointed scissors and needles are required, and several other instruments may

be used and found convenient. An improvised table will be found to be very convenient in autopsying pigs.

After the autopsy has been completed all fragments and portions of organs should be carefully segregated for their proper disposal. Specific instructions should be given the owner or caretaker for cleaning and disinfecting the pens or sheds that may have been contaminated by the carcass or during the autopsy. All autopsy equipment, including instruments and clothing, should be properly cleaned and disinfected before leaving the premises unless special provision is available for disinfection at the veterinarian's office, when a special case should be provided into which all equipment for future disinfection should be placed at once.

All records should be completed during the autopsy, and it is advisable to have a carbon copy made, which may be left with the owner.

RECORDS

A complete description of the case from the clinical history to the deductions as to the cause of death should be recorded. The following form will be found convenient for the keeping of autopsy records:

Owner _____ Address _____ Animal _____

Breed _____ Age _____ Color _____ Sex _____

History _____

Symptoms _____

Date of Death _____ 192 _____ hour _____ M.

Date of Autopsy _____ 192 _____ hour _____ M.

Skin and Sub-cut. Tissue _____

Superficial Lymph Glands _____

Voluntary Muscles _____

Peritoneum _____ Stomach _____

Intestine, small _____ Intestine, large _____

Liver	Spleen
Kidneys	Bladder
Abd. Lymph Glands	
Genital Organs	
Pleura	Lungs
Heart	Vessels
Thoracic Glands	
Brain and Spinal Cord	
Eye, Ear, Nose	Bones
Mouth	Joints
Other items noted	
Cause of Death	
	Autopsy by

TECHNIC

The hog should be placed on its back and held by assistants or secured. The viscera of the abdomen and thorax may be exposed by removing a longitudinal flap by means of parallel incisions extending from two to five inches on either side of the median line, depending upon the size of the animal and beginning about the pelvis and extending to the inferior cervical region, the sternum being a portion of the flap, can readily be separated at the sterno-costal junction. The viscera should then be examined in the order indicated in the record blank shown.

Specimen should be selected from various organs during the progress of the autopsy in order that a laboratory examination may be made if deemed advisable. Inoculation of culture tubes can be made during the autopsy if the operator has provided such equip-

ment. Should cultures be made they should be carefully labelled.

Specimens collected to be sent to a laboratory should be typical lesions and sufficient in size so that they may be readily identified at the laboratory. In packing specimens to send to a laboratory, the following points should be observed:

1. Wet specimens should be packed in a sufficient quantity of borax to prevent leakage of fluids.
2. Select the container that renders the least chance of breakage.
3. All packages should be plainly marked.
4. Remember that postal laws require that fluids and similar materials be placed in properly sealed containers, which must be inclosed in a proper mailing case.
5. Express regulations require that diseased tissues must be placed in a tin, zinc or other metal-lined box, that can be properly sealed.
6. Specimens should be sent so they will reach the laboratory in the shortest possible time. If sent by parcel post, a special delivery stamp should be attached.
7. Specimens of blood for agglutination test or for bacteriologic study should be collected in a clean sterile vial which can be properly sealed. At least 20 mil of blood should be sent for an agglutination test.
8. Portions of tumors for microscopic examination may be packed in borax or 10 per cent formalin, in a proper container.
9. Parasites for identification may be placed in 10 per cent formalin or 25 per cent alcohol.
10. A brain which is to be examined for rabies should be packed in borax.
11. Blood smears may be made on microscopic slides, air dried, labelled and forwarded direct to the laboratory.
12. Samples of pus or wound discharges are preferably collected in clean vials and enclosed in proper mailing cases.
13. A descriptive letter of specimens sent, including the history, symptoms and autopsy findings and instructions as to the examination desired, should accompany the specimens or be mailed at the same time.

Restraint

It is frequently necessary to restrain swine in making a clinical examination or for the purpose of medication. Swine are not cared for individually, excepting some high class pure-bred animals, and

may resent the manipulations necessary in making an examination. An occasional boar is found that is actually vicious, and the handling of such an animal entails some danger to the examiner if proper means of restraint are not used. Swine, although not easily disturbed and excited, will show an increased pulse-rate and respiration when caught and held and if they are run or excited they will show a rise of temperature. Therefore, for the purposes of a clinical examination it is desirable to restrain them by some method that will cause the least disturbance possible. In immunizing simultaneously against hog cholera, the temperatures should be obtained and the procedure should be such as to cause the least possible variation from normal.

In approaching swine, one should proceed slowly and if the swine can be scratched on the back or sides, repeating the process should the animal run away, it will usually require only a few moments before the animal will lie down and permit of a general examination. Little pigs that have not been handled will not submit to the method above outlined, and it is usually necessary to catch and hold them before they can be carefully examined. Care should be exercised in catching little pigs, as they make known their captivity by squealing which will irritate, and frequently make otherwise docile sows vicious. When swine cannot be approached as above indicated, they should be driven into a small pen, or alley, or hurdles may be used to confine them in a small space where if care is used they can be manipulated, carefully observed and their temperatures obtained. Pens 6 ft. square or a little larger, when properly arranged in reference to gates, provide a very convenient means of controlling pigs and shotes to obtain temperatures prior to hog-cholera immunization. Crates are now a common equipment on many farms and will be found convenient for confining a hog while making an examination. It is usually not difficult to drive a hog through properly arranged alleys into a crate.

Vicious boars or other swine can usually be restrained by a snare made of wire, either plain or cabled, cord or rope that is placed over the upper jaw and then secured by fastening to a post or other object. The ensnared animal will invariably pull backward, making the snare taut. A twitch may be similarly employed. When it is necessary to hold a hog by force it should be seized by a leg, the ears, or both, and thrown on its side. Large hogs can be thrown down by two

men. One man should grasp a hind leg and the other man the ears, and by a quick movement the hog is thrown onto its side, and it can be so held by placing one knee on its neck. This method of restraint causes struggling and excitement of the restrained animal and is therefore not advisable for the purpose of making a careful physical examination except for examination for scabies or other conditions in which there are no systemic disturbances. If swine are difficult to catch in a large enclosure, they may be given a small quantity of feed and then caught by slipping up behind them and seizing a hind leg.

In some instances where hurdles, small pens or alleys are not available for confining swine, it may be necessary to snare the animals by means of a rope in which a noose is provided. Such a snare may be arranged over a trough and the hog be caught by the upper jaw, or the noose may be placed on the ground and the hog caught by the foot.

Restraint of swine for medication and the successful administration of medicaments offers considerable difficulty. When it is possible, medicaments are administered in feed or water, and this method has been found to be efficacious in many instances and is desirable when proper results can be obtained.

When medicaments are to be given by mouth, it may be necessary to use a speculum or gag to open the mouth. By the use of a metal dose syringe with a 4 to 6-inch nozzle, fluids may be administered without the use of a speculum or gag. Capsules containing drugs designed to destroy or expel worms, are usually administered by means of a swine balling gun. Such capsules are usually given to pigs weighing from 40 to 100 pounds. A convenient method of restraint for the purpose of giving capsules to this size pig, is to have an assistant seize the pig by both forelegs, straddle the pig's back and raise the pig sufficiently high so that the hind feet will remain on the ground. The pig will usually squeal, and the operator can then introduce the balling gun and deposit the capsule in the pig's pharynx. Care must be exercised in the giving of capsules by means of a balling gun, or the capsule may be deposited in the diverticulum or pocket in the superior part of the pharynx, or the gun may be thrust through the mucous membrane of the pharynx and cause serious trouble. Extensive losses of pigs have occurred as a result of improper administration of capsules. Some prefer to use long forceps for the administration of capsules to pigs.

In the immunization of swine against hog cholera, swine plague, mixed infection and pig scour, various devices have been recommended for restraining the animals. Small pigs and shotes weighing up to 100 pounds may be restrained as for the administration of capsules. Some practitioners have found it convenient to use a V-shaped trough in which the animal is secured by hobbles or ropes or held by an assistant. The trough may be used in an almost vertical position or it may be placed in a horizontal position. When used in a horizontal position a loop of rope may be used to control the pig's head, by placing the loop over the head and an assistant placing his foot on the other end and applying some traction to it. Such equipment does not require many assistants, and is usually so constructed that it can be folded and carried by the practitioner. Special tables have been designed for this purpose, some of which are equipped with a scale for weighing the hog, thus enabling the operator to estimate the proper dosage.

Medication

The administration of drugs to swine, particularly by the mouth, is not always easily accomplished. When possible, it is advisable to mix the medicaments in feed or water. Unfortunately, there is inappetence in the very cases in which medication is desired and the drugs cannot be administered in the food or drink.

Giving medicine in the form of a drench may be done, providing the animal is properly restrained, but the outcome is always problematic, and this method of administration of medicaments should be resorted to only in those cases in which no other form of medication is possible. In giving a drench to swine the fluid should be given cautiously, permitting ample time for swallowing. Pigs and swine weighing up to 150 pounds may be restrained for drenching by having an assistant straddle the back of the animal and grasp both front legs and raise its head slightly. The drench should be administered preferably through a tube or by means of a dose syringe, after gagging by means of a stick or speculum. Larger hogs may be restrained by throwing them and holding them in the decubital position, but it is always dangerous to administer a drench under such conditions. In most cases large hogs and even small swine may be held by means of a snare, and the drenches administered by means of a metal dose syringe. It is always advisable, whether

the dose syringe or tube method is used in drenching, to gag the animal by placing a stick between the upper and lower teeth or to use a speculum. The esophagus of swine is readily dilatable, and it is possible for them to swallow capsules of considerable size; hence fluid medicaments are more safely administered in capsules.

Solids in the powdered form may be administered, after restraining and gagging as above indicated, by the use of a powder spoon, care being taken to see that the medicament is deposited well back on the tongue. Such drugs, however, are best administered in capsule form. Vermifuge in capsules is now available and this is a convenient form in which to administer such a medicament. For the administration of these capsules, swine should be restrained and gagged and the capsule deposited in the pharynx by a balling gun or a pair of long forceps. In the administration the operator must not lose sight of the fact that there is a cul-de-sac in the upper portion of the pharynx and the capsule must not be deposited in that cul-de-sac. The balling gun or forceps must not be forced through the pharyngeal membranes or serious results will follow because vermifuge capsules contain calomel and other chemicals that produce intense inflammation when deposited in the tissues.

THE HYPODERMIC SYRINGE

The most convenient method of administering drugs to swine is by the use of the hypodermic syringe. The active principles of many of the essential drugs are now available in tablet form which when dissolved are administered hypodermatically. By a careful selection of hypodermic tablets the practitioner may avoid the use of drenches in swine. Injections of such drugs must be made intramuscularly, into the axillary space or the peritoneal cavity. Hypodermic injections in swine are slowly absorbed, if absorbed at all, because of the subcutaneous layer of fat. Anti-hog cholera serum and virus and the various bacterins are administered by means of a hypodermic syringe.

Intraperitoneal injection, although not a common practice, is a means of medication that should be more generally employed. Swine are not very susceptible to peritonitis and injections of any ordinary drugs or biologics may be made without injury. Intraperitoneal medication has the advantage of rapid absorption which makes this method of medication advantageous.

Rectal injections are sometimes resorted to in swine. This method is used in the administration of chloral hydrate for the purpose of producing anesthesia. In the use of rectal injections the quantity of fluid injected should not be sufficient to produce excessive dilatation.

Medication through the air passages is indicated in pulmonary strongylosis and probably also in certain cases of chronic bronchitis. This method of medication is available only with those drugs that can be readily vaporized. For the purpose of applying this form of medication it will be necessary to provide a reasonably air-tight box, or room if several animals are to be treated, into which the vapors of the medicament are introduced through a pipe or tube. The medicament should be contained in a bucket with a large tin funnel inverted over the top, and the small end of the funnel connected to a tube extending into the box or room containing the patients. The vaporization is accomplished by means of a coal oil or gasoline stove.

Anesthesia

Generally speaking, anesthesia is seldom resorted to in swine. Most books on surgery and articles in periodicals rarely more than mention swine anesthesia. Possibly this is due to the fact that surgical operations in swine are not common. Certain conditions develop in swine in which surgical interference becomes a necessity; therefore some definite method of anesthetizing is of distinct advantage.

INDICATIONS

Anesthesia in swine is indicated in all cases requiring major surgical operations, such as cesarean section, and removal of a scirrhous cord.

ANESTHETICS AND ADMINISTRATION

Chloroform has been used and it sometimes produces desirable results. The A. C. E. mixture is less dangerous and usually as effective as chloroform. Swine are rather susceptible to chloroform, and the various chloroform combinations and such agents must be used with care, otherwise, poisoning and death may occur. When chloroform or the A. C. E. mixture is used, it should be given slowly by inhalation and considerable quantities of air must be admitted to prevent poisoning.

Ether may be used for a general anesthetic in swine but must be carefully administered.

Chloral hydrate is a narcotic that is probably more applicable to swine, as it is much less dangerous than chloroform or ether. Chloral is easily administered in solution by rectal injection. The usual dose is one dram per 100 pound weight of the hog. It requires about twenty minutes to produce stupor, although in some cases profound narcosis will result within twenty minutes after the chloral has been administered.

Some practitioners use a combination of chloral and chloroform, administering the chloroform about fifteen to twenty minutes after the chloral is injected. This combination should be employed in cases in which it is necessary to maintain anesthesia for a long period of time.

Other practitioners have reported good results from the administration of H. M. C. tablets dissolved and injected into the ear vein. The dosage for a mature animal is one tablet composed of hyoscin 1-100 grain, morphin $^1/_4$ grain and cactoid 1-64 grain. About fifteen minutes are required after the injection before the influence of the drug is noted and operations such as cesarean section can be done within twenty to twenty-five minutes.

CHAPTER II

DIGESTIVE SYSTEM

Anatomic consideration
Physiologic consideration
Mouth and its associated parts
- Lips
  - Malformations
  - Cheilitis — Catarrhal; Suppurative; Diphtheritic; Vesicular
  - Tumors
- Tongue
  - Foreign bodies and injuries
  - Glossitis
  - Tumors
  - Parasites
- Buccal Membrane
  - Inflammation — catarrhal (acute; chronic); phlegmonous
  - Epizootic aphthae — vesicular
  - Scurvy — diphtheritic
- Teeth

Parotitis
Tonsils
Pharynx
- Injury
- Inflammation — catarrhal; phlegmonous; diphtheritic
- Paralysis
- Tumors

Esophagus
- Malformations
- Stenosis
- Dilatation
- Perforation

- Inflammation
- Tumors

Aberration of appetite

Stomach
- Malformations
- Foreign bodies
- Vomition
- Anemia
- Hemorrhage
- Peptic ulcers
- Hyperemia
- Inflammation
  - catarrhal
  - croupous
  - phlegmonous
- Dilatation
  - acute
  - chronic
- Tumors
- Parasites

Intestines
- Malformations
- Hemorrhage
- Obstruction
- Dilatation
- Emphysema
- Inflammation
- Poisoning
  - sodium chloride
  - caustics
  - phosphorus
  - phenol
  - corrosive sublimate
  - cocklebur
  - night shade
  - garbage
  - cryptogam
  - cottonseed meal
- Parasites
- Tumors

Diarrhea

Constipation

Prolapse—Anus and rectum

Liver
- Malformations
- Foreign bodies
- Rupture
- Icterus
- Cloudy swelling
- Fatty changes
- Amyloid changes

- Glycogenic changes
- Gall-stones
- Hyperemia
- Inflammation
  - suppurative
  - parenchymatous
  - chronic interstitial
  - acute interstitial
- Tumors
- Parasites

Pancreas

Peritoneum

- Injuries
- Ascites
- Inflammation
- Tumors
- Parasites

ANATOMIC CONSIDERATION

Mouth

The mouth in swine is relatively large due to the extension well backward of the labial fissures. The upper lip blends imperceptibly with the nose, forming the snout. The lower lip is short, closely adherent to the maxillae and distinctly pointed. The cheeks are proportionally small because of the deep labial fissures. The hard palate is long and has a median groove, on each side of which are about twenty ridges.

The soft palate is thick, about 2½ inches long and is nearly horizontal. There may be a rudimentary median prolongation of the soft palate. On either side of the oral surface there is a groove and laterally there are raised areas—the tonsils which extend on to the lateral walls and tongue.

Tongue

The tongue is long, relatively narrow and thin at the tip. The mucous membrane lining the lips, cheeks and covering the hard palate is relatively smooth.

Salivary Glands

Parotid glands.—These glands are triangular in shape, located at the base of the ear. The duct discharges opposite the upper fourth or fifth molar.

Submaxillary glands.—These glands are smaller than the parotid and are of a darker color and their ducts discharge near the fraenum linguae.

Sublingual glands.—These glands consist of two parts on either

Fig. 12. Dentition of lower jaw of three-months-old pig. (Ostertag).

side and are located near the angle of the maxilla. One portion of the glands terminates in a single duct which discharges near the duct of the submaxillary gland. The other portion—the true sublingual gland—is relatively flat and is located anterior to the former.

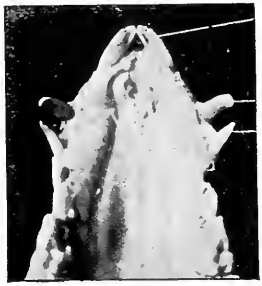


Fig. 13. Dentition of upper jaw of three-months-old pig, with milk nippers, corners and canines; middle incisors just breaking through. (Ostertag).

The secretion from this portion of the sublingual discharges through six or eight openings along the lower portion of the dental arcade.

Teeth

The hog possesses the typical number of teeth for mammals. Normal pigs have eight temporary teeth when farrowed: four incisor

and four canine, or tushes. The formula for the temporary teeth is as follows:

$$2\left(\text{I}\,\tfrac{3}{3}\,\text{C}\,\tfrac{1}{1}\,\text{P}\,\text{M}\,\tfrac{4}{4}\right)=32$$

Fig. 14. Dentition of an 18-months-old pig (upper jaw) with permanent incisors only. (Ostertag).

The upper permanent incisors are distinctly separated from each other and there is considerable space between the lateral incisor and the canines. The lower incisors are nearly horizontal. The

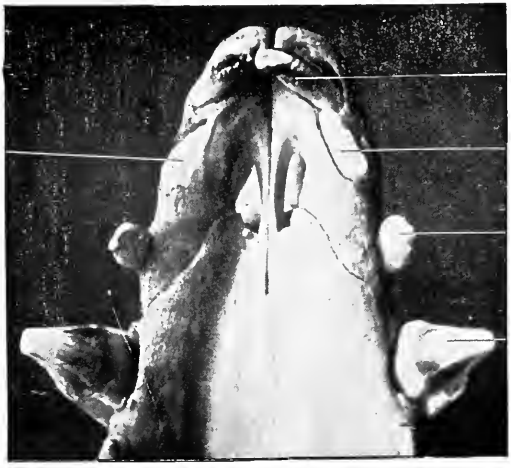


Fig. 15. Dentition of lower jaw of an 18-months-old pig, with permanent incisors only. (Ostertag).

incisors are covered with enamel. The canines, or tushes, are larger in the boar. In extreme cases the upper canines may reach a length of 4 inches and the lowers 8 to 10 inches. These teeth are relatively small in sows.

The first premolars are separated by a space from the canines and are relatively small. The premolars increase in size from the first to the fourth. The first and second molars are larger than the fourth premolar, but the third molar is relatively small.

The formula for the permanent teeth is as follows:

$$2\left(\mathrm{I}\ \tfrac{3}{3}\ \mathrm{C}\ \tfrac{1}{1}\ \mathrm{P}\ \mathrm{M}\ \tfrac{4}{4}\ \mathrm{M}\ \tfrac{3}{3}\right) = 44$$

The average periods of eruption of the teeth of swine, according to Sisson, is as follows:

	Temporary.	Permanent
I_1	2-4 weeks	12 months
I_2	upper—2-3 months lower—1½-2 months	16-20 months
I_3	Before birth	8-10 months
C	Before birth	9-10 months
PM_1	5 months	12-15 months
PM_2	5-7 weeks	
PM_3	upper—4-8 days lower—2-4 weeks	
PM_4	upper—4-8 days lower—2-4 weeks	
M_1		4-6 months
M_2		8-12 months
M_3		18-20 months

PHARYNX

The pharynx is an irregular cavity common to the digestive and respiratory system and is located posterior to the posterior nares and mouth and anterosuperior to the larynx and esophagus. There is a median fold of mucous membrane superiorly, on either side of which is the opening of the eustachian tube. In the posterior portion of the pharynx there is a cul-de-sac, which is the source of much annoyance in the administration of capsules.

Esophagus

The esophagus is short and of relatively large caliber. According to some authorities objects, from $1\frac{1}{2}$ to 2 inches in diameter, can pass through the esophagus readily. The mucous membrane of the anterior portion is richly supplied with mucous glands.

Stomach

The stomach of swine is simple but relatively large. There is a cardiac and pyloric portion but the division is not distinctly out-

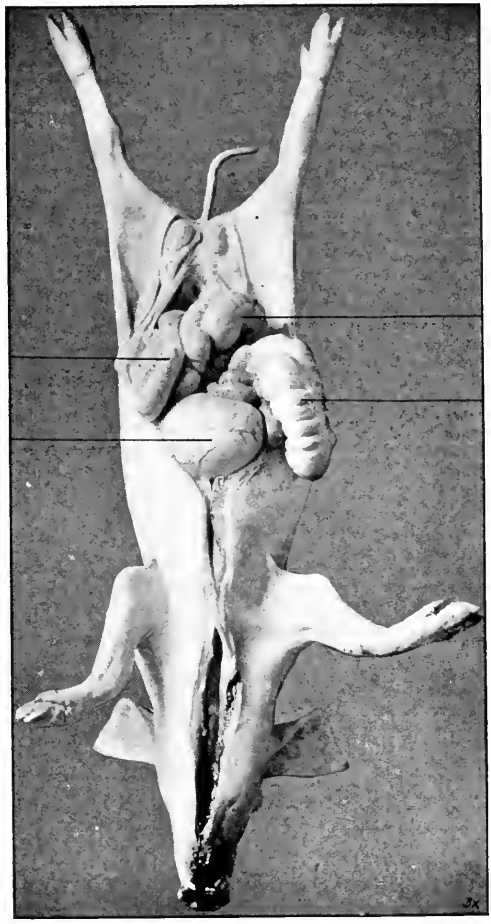


Fig. 16. Stomach and intestine of swine after complete opening of the abdomen. (Ostertag).

lined. There is a cul-de-sac at the esophageal opening into the cardiac division. The mucous membrane varies in character in different portions of the stomach. The mucosa surrounding the esophageal opening partakes of the nature of the esophageal mucosal mem-

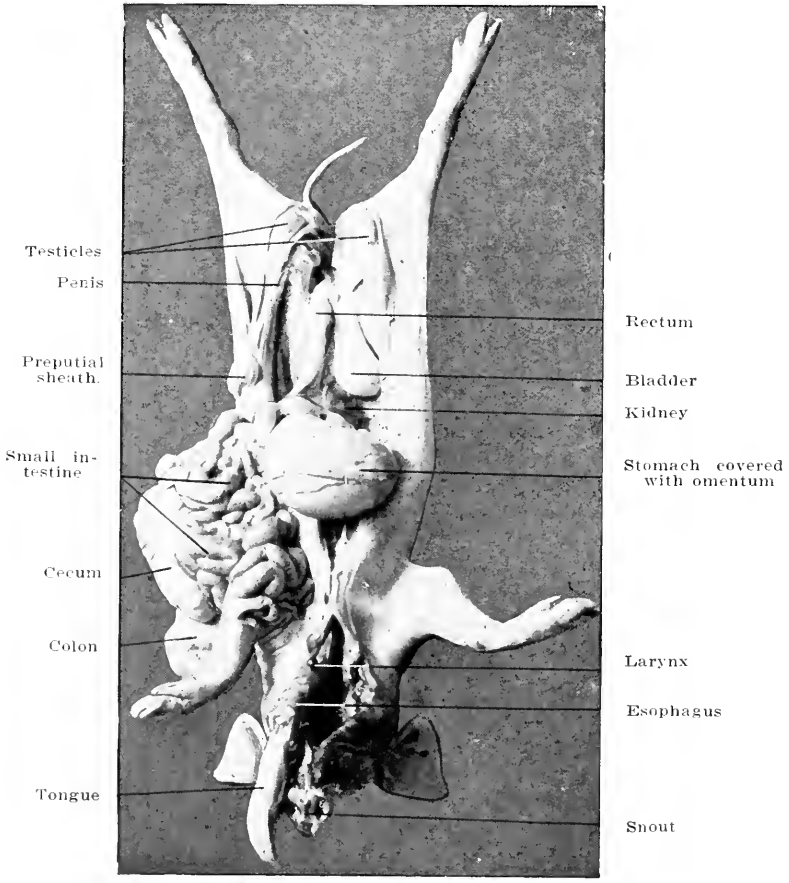


Fig. 17. Stomach and intestine of swine after incomplete opening of the abdomen. (Ostertag).

brane. The cardiac mucosa is thin and of a pale gray color. The fundus gland area located in the greater curvature between the cardiac and pyloric portions, is characterized by a thick mucous membrane of a deep red color. The pyloric mucosa is relatively thin and is of a pale pink color.

Intestine

The capacity of the intestine is relatively less than the intestine of herbiverous animals.

Small intestine.—The small intestine is about 60 feet in length in mature swine. The mesentery of the small intestine varies from 2 inches in length in the first portion (duodenum) to 7 or 8 inches long in the latter portion (ileum). The bile duct opens about 2 inches from the pyloric opening and the pancreatic duct about 5 inches beyond it. Band-like masses of lymphoid tissue composing Peyer's patches and solitary follicles are usually prominent and

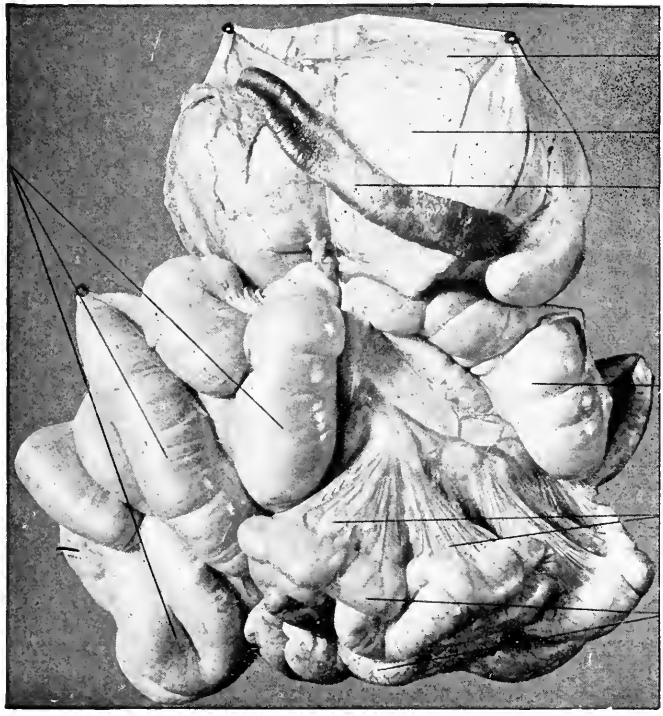


Fig. 18. Exenterated stomach, intestine and spleen of swine. (Ostertag).

easily observed, beginning about 20 inches beyond the pylorus and continuing into the cecum. The small intestine is divided for description into three parts designated from the stomach backward: duodenum, jejunum and ileum.

Large intestine.—The large intestine of a mature hog is about

fourteen feet in length. This portion of the intestine is of much larger caliber than the small intestine. The large intestine is divided for descriptive purposes into three sections: the cecum, colon and rectum. The cecum is about ten inches in length, terminates in a

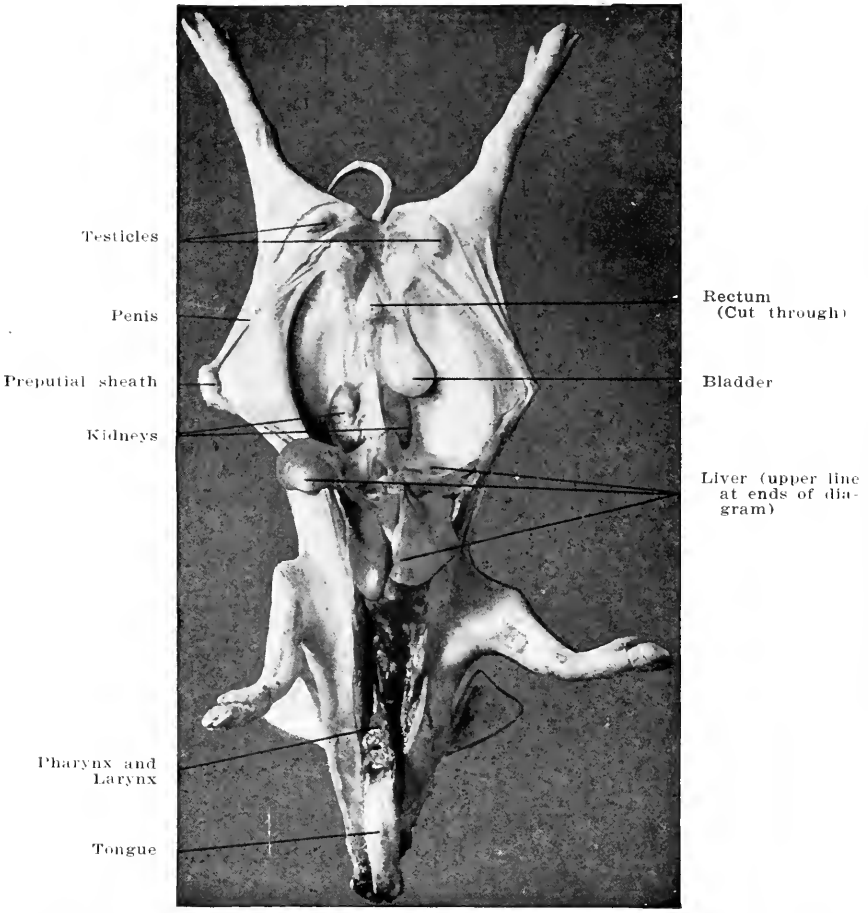


Fig. 19. Liver of hog in natural connection with diaphragm, also urino-genital organs in natural position. (Ostertag).

blind end and is joined by the ileum and communicates with the colon in its upper portion. Peyer's patches usually extend into the cecum and there are three longitudinal muscular bands in the cecum. The colon is about twelve feet in length and is arranged in three

double spiral coils. There are two incomplete longitudinal bands in the colon. The mucous membrane contains many solitary follicles, and Peyer's patches may extend into the first portion of the colon. The rectum is twelve to fifteen inches in length and is usually surrounded with fat.

Liver

The liver of swine is relatively large, weighing about four pounds in a mature animal. It is centrally located although the major portion is to the right of the median line. It is of a brownish red color and the lobules are usually distinctly outlined. The central portion is thick, the margins thin, and it is divided into four prin-

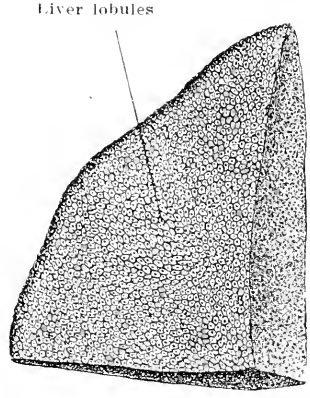


Fig. 20. Piece of swine liver showing lobules. (Ostertag).

cipal lobes by three fissures. The gall-bladder is located in a depression on the posterior surface of the right central lobe. The posterior vena cava passes through the substance of the liver and enters the thorax through a notch. The liver is maintained in its position by the other viscera and two coronary ligaments, although rudiments of other ligaments are sometimes present.

Pancreas

The pancreas is irregularly triangular in shape and is attached to the duodenum. The pancreatic duct passes through the duodenal wall opening about five inches from the pylorus.

PHYSIOLOGIC CONSIDERATION

Digestion

By digestion is ordinarily meant the bringing into solution of materials that are consumed as food. Swine, in their natural state, feed from substances obtained by rooting, the feeds consisting of roots, nuts, etc. For this purpose, nature provided swine with a long snout, well supported, and a lower lip that is pointed and rather mobile. By breeding and selecting and providing ample food, the structure of the swine snout has been altered. The natural habit of rooting is readily prevented by ringing.

The prehension of food by swine is accomplished by means of the snout and lower lips, the teeth of swine are not well adapted for grazing. The mastication of food by swine is not thorough, as they usually swallow the food almost as rapidly as it is prehended. The esophagus of swine permits the passage of relatively large masses, which further relieves the necessity of thorough mastication.

Gastric digestion of meats and allied products is not as perfect in swine as in carnivorous animals, and the digestion of vegetable substances is not as perfect in swine as in herbiverous animals. The food is not completely mixed in the stomach for several hours and, according to investigators, the type of digestion differs in the cardiac and pyloric portion of the stomach. In the cardiac portion of the stomach, starch is converted into sugar by the action of saliva. Lactic fermentation is also occurring at the same time. Digestion of albumin occurs in the pyloric portion of the stomach but usually does not begin until three or four hours after consumption of food and continues for several hours thereafter.

Bile is secreted in quantities ranging from 1000 to 1200 grams per day. There are no digestive ferments in the bile of swine, but it has the property of emulsifying fats. Bile of swine is greenish yellow or yellowish brown, is odorless and alkaline in reaction.

The pancreas of swine, as in other animals, apparently has periods of rest, during which no pancreatic juice is secreted. While active, this gland produces from five to ten grams of pancreatic juice per hour. Pancreatic juice contains ferments that digest fats and albuminous substances and that also emulsify fat. Intestinal digestion, therefore, includes the peptonization of albuminoids, the conversion of starch into sugar and the emulsification of fats. The reaction of the first portion of the intestine in swine is acid and the latter

portion is neutral or alkaline. The intestinal movements in swine are similar to those in the horse.

The Mouth and Its Associated Parts

The mouth of swine is prone to injuries and infection because they are likely to ingest foods in various states of refinement, and not infrequently they consume foreign bodies that may produce such injuries as contusions and lacerations. The comfort and health of swine are not always considered by the feeder, who may thoughtlessly give foods sufficiently hot or cold to produce damage to the buccal mucous membrane. Injuries to this membrane are predisposed to infection that may produce pathologic conditions, varying from simple inflammation to suppuration or even necrosis.

Lips

MALFORMATIONS

Malformations of the lips of swine are not rare, the most frequent malformation being the condition popularly termed harelip (*schistosis labia*). This condition is rarely observed in mature swine, because the defect renders nursing extremely difficult and frequently impossible; such pigs, therefore, die before they have passed the nursing stage. Schistosis labia, when not associated with other developmental errors, can usually be sufficiently relieved by surgical interference that the pig can suckle and develop to maturity.

In operating to relieve harelip the fibrous tissue on either side of the fissure should be dissected away and the skin surfaces freshened, after which the fissure is closed by suturing with silk. It may be necessary to feed the pigs for two or three days after the operation.

CHEILITIS

The lips are also subject to injuries inflicted by rough foods or by foreign bodies in the food. Wounds, too, may be inflicted by dogs. Because of their location, lip wounds are predisposed to infection. Inflammatory processes of the lips are usually confined to the mucous surface.

Catarrhal cheilitis is of rather common occurrence, particularly in small pigs, and may be either acute or chronic. This condition is usually caused by improper food or by undue exposure to very

dry atmosphere. The lesions of the acute type consist of small crevices which in extreme cases may bleed freely. In the chronic type the cracks and crevices become more extensive and the surrounding tissues are infiltrated with varying quantities of newly formed fibrous tissue. Catarrhal cheilitis, either acute or chronic, is not a serious condition and is usually corrected when the cause is removed. The irritated infected areas of the lips should be thoroughly cleaned with a lukewarm 1 per cent solution of salt, after which it is advisable to apply some antiseptic.

Suppurative cheilitis is occasionally observed. It is usually the result of infection of the subsurface labial tissues with pyogenic bacteria. The usual form of this type of cheilitis is circumscribed, and the lesions are similar to the lesions observed in the usual abscess formation. This condition is relieved by operation. The small abscesses should be opened freely with a sharp-pointed bistoury and the pus removed, after which the wound should be painted with tincture of iodin.

Necrotic cheilitis is very prevalent in some sections of the United States, particularly in young pigs. The usual causative agent is the Bacillus necrophorus. This microorganism produces a variety of lesions and is of so great economic importance that all of the disease processes resulting from it will be discussed under the topic, "Necrobacillosis."

Vesicular cheilitis has been reported as occurring in suckling pigs. This condition is probably caused by a yeast, the oïdium albicans. The lesions of vesicular cheilitis are practically confined to the mucous surfaces of the lips. The mucous membrane is tumefied and scarlet red in color, and in the beginning and later small, sharply circumscribed vesicles appear and the mucosa becomes white, due to the accumulated desquamated epithelium and mucus. The vesicles rupture and the vesicular membrane may slough, leaving a denuded surface, or the vesicular membrane may collapse after the discharge of its contents and appear as a small, white mass upon the mucous membrane. This condition is usually not serious, although it may cause considerable inconvenience in sucking. It is usually relieved by the topical application of properly selected antiseptics.

TUMORS

Labial tumors are not of common occurrence in swine, although fibroma, myxoma, and epithelioma have been observed.

Tongue

The tongue is subject to injuries of various types. Tongue injuries may be inflicted by improper food, by foreign bodies in the food, or by sharp, irregular teeth.

The symptoms of injuries or foreign bodies in the tongue consist of persistent champing of the teeth, moving the head from side to side while prehending or chewing food and more or less ptyalism. When such symptoms are evidenced a thorough examination should be made after the animal has been properly restrained. The procedure for relief will depend upon the causative factor. Nails, splinters, or other foreign bodies should be removed and the wound

Fig. 21. GLOSSITIS. This tongue taken from an apparently normal hog, contained twenty-four polished nails lodged in one place.

swabbed with tincture of iodin. Ragged edges of lacerated wounds should be removed before antiseptics are applied.

GLOSSITIS

Inflammatory disturbances of the tongue may involve the mucous membrane only or the submucous muscular portion of the tongue. The inflammations of the lingual mucous membrane are practically identical with those of the lips and will not be given further consideration. Inflammation of the lingual musculature is usually the sequel of an injury which had provided an avenue of entrance for infection. Inflammation of the substructures of the tongue may be

acute or chronic, diffuse or circumscribed, nonsuppurative or suppurative.

Diffuse nonsuppurative subsurface glossitis is usually acute and is the result of infection with streptococci or some septic microorganism. The lesions in this type of glossitis consist of a diffuse, extensive tumefaction of the tongue, which on section evidences enlargement of the blood vessels and abundant accumulations of pus, or other inflammatory products, between the muscle bundles, while the muscle tissue presents a parboiled appearance.

Acute circumscribed subsurface suppurative glossitis partakes of the nature of an abscess.

Chronic glossitis is most frequently diffuse and is exemplified in cases of diffuse lingual actinomycosis. The lesions consist primarily of an excessive quantity of fibrous tissue which may contract unequally in different portions of the tongue, thus producing an irregularity of the surface of the organ. Portions of the tongue in which excessive quantities of fibrous tissues are developed become dense and hard, and cut with considerable resistance.

The symptoms evidenced in acute glossitis are difficulty of prehension and mastication, irregular movements of the head, champing of the teeth, and in extreme cases refusal of food and drink and the dribbling of saliva or saliva mixed with pus and in some instances there will be more or less blood mixed with the saliva.

Diffuse suppurative glossitis is not common. It should be treated by mild antiseptics, using agents that are not injurious should they be swallowed. Abscesses of the tongue when so located that it is possible to operate, can be relieved by making a good free incision (lengthwise of the tongue) and permitting the pus to escape, after which the wound should be swabbed with tincture of iodin. Actinomycosis of the tongue may be diagnosed by examination of pus, providing pus centers have formed and there is no great development of fibrous tissue. These cases may be relieved by the administration of potassium iodid in 10 to 15 grain doses once daily for a period of ten days, then withholding the medicine for ten days and repeating for another ten-day period.

TUMORS

Lingual tumors are relatively uncommon, but retention or obstruction cysts have been observed.

PARASITES

Parasitic invasion of the tongue is not uncommon. The cystic form of the Tænia solium, that is, the cysticercus cellulosæ, frequently occurs in the muscular portion of the tongue. The cystic form of the Trichinella has also been observed in lingual muscles, while psorosperms occasionally inhabit the muscle of the tongue. The cysticercus cellulosæ may be identified if the cysts are located superficially. They are a trifle smaller than a navy bean and palpation, if they are of recent development, will demonstrate that they contain fluid, and if a cyst be punctured the bladder worm and fluid will escape.

The cystic form of the Trichinella produces an inflammation which is at first acute but later becomes chronic.

Swine affected with cysticercosis or trichinosis cannot be relieved and should be slaughtered where there is proper inspection to safeguard the meat-consuming public.

Buccal Membrane

The mucous membrane of the mouth, other than that mentioned in relation to the lips and tongue, is subject to injuries of a similar origin and nature and will not be further discussed here.

STOMATITIS

Catarrhal inflammation of the buccal mucous membrane is relatively common and may be local or general, acute or chronic.

Acute catarrhal stomatitis is usually caused by the ingestion of improper food, although it may be associated with some general infective disease or be the result of injury.

Fermented foods may contain acids or other injurious chemical substances that irritate the buccal mucosa and produce inflammation. Foods containing awns, beards, thorns, glass, or other foreign bodies, may produce injuries of the membrane of the mouth, thus providing an avenue of entrance for various microbian agents. Disinfecting solutions such as phenol, dips and corrosive sublimate, may contaminate feed troughs or feed and may be sufficiently irritating to produce stomatitis. Too concentrated medicine may also produce stomatitis. Irritation may be caused by moldy feeds. The practice of catching swine by means of a rope or wire over the

upper jaw is very likely to produce injury to the buccal mucous membrane.

Symptoms: The affected mucous membrane is in the beginning tumefied and increased in redness, and later the surface becomes coated by the accumulation of desquamated epithelium and mucus. Gradually this surface coating loosens and sloughs as the inflammation diminishes in intensity. The affected animals refuse to eat or eat sparingly, and usually select soft foods. Although they may attempt to chew hard substances, as a rule they drop them quickly to the ground. Salivation is always present, and in extreme cases an offensive odor may be detected.

Treatment: The treatment consists in cleansing the affected parts with antiseptics and applying an astringent, such as myrrh. The affected animals should be given mucilaginous fluids, soft foods, and a good supply of clean, cool water.

Chronic catarrhal stomatitis is caused by the continuous or prolonged action of some relatively mild irritant.

Lesions: This condition is associated with fibrous proliferation in the submucosa, which in the early stages of the disease results in tumefaction of the mucosa. Later the newly formed fibrous tissue contracts, producing an irregular surface. There is also a gradual atrophy of the mucosa and occasionally the cicatrized fibrous tissue obstructs the mucous gland ducts, thereby causing small retention cysts.

Chronic catarrhal stomatitis is manifested by continuous limited salivation and champing of the jaws. The treatment depends largely upon the progress of the disease. In all cases the cause should be determined and removed. Soft foods should be given, and mild astringent antiseptic washes may be used.

Phlegmonous stomatitis is relatively common in swine. It is usually caused by a steptococcic infection of the submucosa. The condition is usually general, the affected mucosa is intensely swollen and in the beginning is scarlet red in color, later assuming a purplish hue, and finally a dull gray, due to the accumulation of desquamated epithelium, mucus, and pus. Patches of mucous membrane may become necrotic and slough, leaving a red surface from which blood escapes freely. The tumefaction may be so intense that the mouth cavity becomes noticeably diminished, and the cheek mucous membrane may be forced between the teeth and lacerated during mastication.

The affected animals refuse to eat, and although they frequent the drinking trough, they actually drink very little. There is a frothy, ill-smelling discharge from the mouth. There may be a rise in temperature of from one to three degrees Fahrenheit. The treatment consists of mouth washes of antiseptics, frequently applied.

Vesicular and *ulcerative stomatitis* is caused by the same agencies and presents lesions similar to vesicular cheilitis, and will not be further discussed.

Necrotic stomatitis is not uncommon, particularly in suckling pigs. The further discussion of this condition will be found under the topic, Necrobacillosis.

Symptoms.—As above indicated, the symptoms of stomatitis of the various types vary only in intensity. There is more or less salivation and drooling, champing of jaws, and evidence of difficulty in mastication. On inspection the lesions will be evident, which are usually sufficient upon which to base a diagnosis.

Treatment.—The treatment also varies with the type of inflammation. In all instances the cause should be removed, and in the infectious types there should be topical application of some suitable antiseptic.

EPIZOOTIC APHTHAE

Foot-and-mouth disease of swine is manifested primarily by lesions of the feet, but the buccal mucous membrane and skin of the snout may be involved. The mouth lesions consist of vesicles of the mucous membrane of the lips and mouth. The vesicles vary in size and are usually of short duration. There will invariably be involvement of the coronary bands and a general systemic disturbance which will be sufficient evidence for differential diagnosis. A general description of this disease will be found in the chapter on infective diseases.

SCURVY

This is a disease manifested by ulceration and hemorrhage of the gums, unthriftiness, and debility. It is of rather common occurrence in young pigs.

Etiology.—There appears to be no specific exciting cause of this condition. However, it usually occurs in pigs that are improperly fed, kept in insanitary quarters, or in pigs produced from continued inbreeding.

Lesions.—Scurvy is characterized by progressive ulceration of the

gums. These ulcers are irregular, ragged, and bleed almost constantly. Petechial hemorrhages may be found in the skin, and in the mucous and serous membranes. The liver and kidneys may show fatty changes. The spleen and lymph-nodes are enlarged.

Symptoms.—Progressive emaciation, dullness, diminished appetite, increased thirst, and a dislike to move, characterize scurvy. On inspection, gum ulcerations will be observed, and cutaneous hemorrhages may also be visible. The disease is rather serious unless the cases are observed early.

Teeth

Defects of the teeth occur in swine and are in some cases responsible for failure of development or loss of condition. Irregularities of the teeth frequently cause injury to the tongue or buccal mucous membrane.

Such disturbances are manifested by quidding of feed, salivation and unthriftiness. The method of producing relief in such cases will depend upon the nature of the irregularity. It may be necessary to extract one or more teeth, which is ordinarily not difficult to do if the hog is properly restrained. Foreign bodies may be lodged and become wedged between the teeth and produce a chain of symptoms as above enumerated. Foreign bodies can usually be removed with little difficulty by means of dressing forceps.

The canine teeth, or tushes, frequently become very long, especially in old boars, and they are sometimes used as a means of offense. They can usually be cut off by means of bone forceps or molar cutters, the animal being properly restrained.

Little pigs frequently fight each other, producing scratches and injuries to the skin from their small sharp teeth. These injuries are of no consequence, unless they become infected.

Parotid Glands

Injuries of the parotid glands may occur. The most frequent injuries are inflicted by dogs or they result from fighting. The careless use of stanchions or pinchers in restraining swine may produce injuries of these glands.

PAROTITIS

Parotitis is rare in swine. This condition may be the sequel of an injury or it may occur as a result of extension of infection from the buccal mucosa. Inflammation of the parotid glands is manifested by swelling below the ear near the angle of the jaw. There

is usually considerable pain when the gland area is palpated, and the animal may refuse to eat because of the distress occasioned by movement of the jaws. In docile swine the pain may be relieved by the local application of hot water or poultices. Soft slop foods should be provided. If an abscess develops it should be opened and treated as any ordinary abscess.

Tonsils

The tonsillar tissue of swine is prone to either acute or chronic inflammation.

TONSILLITIS

Acute tonsillitis is closely associated with acute pharyngitis, and the cause is probably most frequently infectious in character. The tonsillar tissue becomes tumefied and projects above the surface, while the buccal mucous membrane is hot and red. The affected animals are indisposed and dull, and have a tendency to extend the head and elevate the snout. There is usually a rise of temperature. Deglutition is difficult and may be associated with gagging and sometimes with vomition. There may be spasmodic coughing.

The treatment consists, in the mild cases, in applying soothing astringents; in the more severe cases, tincture of iron chlorid may be used. Laxatives should be given to keep the bowels in an active state, and the animals should be placed in clean, well-ventilated quarters, and given liquid and easily digested foods.

Chronic tonsillitis is less common than the acute form. It is characterized by distention of the tonsillar tissue, by accumulated desiccated pus or by calcareous masses in the tonsillar crypts.

Pharynx

The pharynx, like the mouth, is subject to traumatisms and infection. Probably the most frequent injury of the pharynx is due to the use of the balling gun. The cul-de-sac in the posterior portion of the pharynx is the usual location of injuries induced by the balling gun. It is probable that in the majority of instances there is no direct injury inflicted but the capsule is deposited in the cul-de-sac and the capsule is soon dissolved and the contents liberated. If the capsule contained irritants or erosives, such as calomel, intense inflammation will be established. Not infrequently such drugs will erode the mucous membrane of the cul-de-sac and the

inflammatory process thus extend into the peri-pharyngeal tissues. Less frequently the balling gun is forcibly thurst into the pharyngeal cul-de-sac and the mucous membrane is lacerated or injured.

The symptoms manifested in swine in which the cul-de-sac has been injured direct by means of a balling gun or indirectly by the deposit of a capsule, develop rapidly, being very evident within a few hours. The affected animal coughs more or less continuously, because of the irritation of the pharyngeal mucosa. If a capsule be deposited into the cul-de-sac it will be very difficult for the affected animal to remove it. It will cause labored breathing and wheezing. Within 12 to 18 hours there will be marked swelling in the cervical region. The animal by this time is usually unable to swallow and dies apparently of asphyxiation.

The lesion found in these cases will consist of inflammation of varying intensity in the peripharyngeal tissue and if the tissues are carefully dissected, the origin of the inflammatory process may be traced to the pharyngeal cul-de-sac, where lacerations may be found and where the evidence of the contents of the capsule can be observed.

PHARYNGITIS

Inflammation of the pharyngeal mucosa is relatively common in swine. This condition is frequently associated with laryngitis. Pharyngitis is probably most common in the early spring and especially in swine that are out in pasture where they have access to cold water, which is a common cause of the condition. It is reported to be relatively common in mountainous sections, probably because of the cold water in the mountain streams.

Pharyngitis is not confined to swine of any particular age but affects mature hogs, feeders and little pigs.

Three different types according to lesions of the pharyngitis have been recognized in swine: catarrhal, phlegmonous and necrotic or diphtheritic.

Catarrhal pharyngitis is the most common type of inflammation, and may be either acute or chronic. The usual cause of the disease is improper food, cold water or undue exposure, although it may be caused by infection.

The mucous membrane of the pharynx affected with acute catarrh is in the beginning dry and scarlet red, later becoming tumefied and

coated with epithelium and mucus, which occasionally desquamates, leaving denuded areas.

If the causative agent persists the condition becomes chronic. The chronic condition is evidenced by fibrous proliferation in the submucosa resulting, first, in tumefaction, and then in protrusion of the pharyngeal mucosa, which may, by contraction of the newly formed fibrous tissues result in a corrugation of the mucous membrane, or the newly formed fibrous tissues may be so extensive that the pharyngeal mucosa becomes uniformly tumefied, dense and hard. In either case the epithelium of the mucous membrane becomes atrophied, leaving only a thin covering, usually of a squamous type of epithelium.

Phlegmonous pharyngitis is not infrequently associated with phlegmonous stomatitis, although it may occur independently. Streptococci are the usual cause of phlegmonous pharyngitis, and the lesions are practically identical with those of phlegmonous stomatitis.

Necrotic pharyngitis is not rare in swine. It is the result of the Bacillus necrophorus, and practically the same lesions are observed as in necrobacillosis.

The symptoms of pharyngitis are as follows: Cough, which in the beginning is dry, but later becomes moist and is always painful. Deglutition is painful and the affected animals prefer soft foods or slops. In severe cases there is anorexia. There will be some drooling and the escaping saliva will be stringy. There is retching and frequently vomiting. There is usually one to three degrees F. rise in temperature in the phlegmonous and necrotic types.

The first step in the relief of pharyngitis is to remove the cause. The affected animal or animals should be placed in clean comfortable quarters. If the affected animals will eat or drink, then it may be possible to medicate them in the feed or water, giving mild astringents. In valuable individuals it is advisable to give medicaments by inhalation in the form of vapors, using such agents as oil of eucalyptus.

PARALYSIS

Paralysis of the pharynx is a condition resulting from disturbances of the controlling pharyngeal nerves or of the muscles of the pharynx. This condition is usually associated with rabies, although it has been observed independent of that disease and probably

resulted from the influences of some substance upon the deglutition centers of the medulla.

TUMORS

Pharyngeal tumors in swine are not very common. Occasionally polypoid fibromas are observed, but they are rare. Of the malignant tumors the epitheliomas are most often met with; however, these are rare. Adenomas and carcinomas also have been observed, but infrequently.

Esophagus

MALFORMATIONS

Malformations of the esophagus are rather rare. The canal may end abruptly at the lower end of the upper third, beginning lower down, and continue to the stomach, or the esophagus may form a union with the trachea. In rare instances fistulous openings have been observed in the cervical region.

STENOSIS

Stenosis, or narrowing of the esophagus, is not infrequent. This condition occurs most frequently at the pharyngo-esophageal junction or at the cardiac termination, the cause being either extrinsic or intrinsic.

Etiology.—Among extrinsic causes may be pressure from enlarged thyroids, tumors, aneurysms, or abscesses. Foreign bodies, too, often produce partial obstruction of the esophagus, thus causing a temporary stenosis. The intrinsic causes are more frequently due to scars or scar tissues that have formed as a result of injuries or of diseased processes of the esophageal tissues. Hyperplasia of the esophageal muscle, also, may produce stenosis.

Lesions.—The usual anatomical changes observed in esophageal stenosis consist of cicatrized fibrous tissue. The extent of the trouble varies, but as a rule it involves only a small portion of the esophagus. The stenosis may form a regular or irregular diminished lumen.

Symptoms.—The symptoms evidenced in esophageal stenosis consist of difficult deglutition and sometimes dilatation (which see), succeeded by the formation of jabot, which may be observed in animals thin in flesh.

Treatment.—Surgical interference, which may or may not be suc-

cessful, depending upon the extent of the lesions and the age of the animal involved, is the only treatment for esophageal stenosis.

DILATATION

Esophageal dilatation is less frequently met with than stenosis, particularly in swine.

Etiology.—Obstruction and stenosis of the esophagus are primary causes of esophageal dilatation, but it may be the result of traction from without.

Lesions.—Dilatation usually affects the entire circumference of the esophagus, although in some instances the dilatation may be lateral and form a true diverticulum. In the dilated portion, the esophageal walls are usually attenuated, and, in rare instances, they may become so weak that they are easily ruptured.

Symptoms.—The usual symptoms evidenced in an animal afflicted with esophageal dilatation consist of a gradually developing tumefaction or enlargement in the cervical region while the animal is eating, due to the accumulation of food in the dilated portion of the esophagus. The enlargement gradually subsides after eating, until no enlargement is observed.

Treatment.—The treatment of esophageal dilatation is of little avail, and is primarily confined to surgical interference.

PERFORATION

Esophageal perforation is not very common in swine.

Etiology.—It may be the result of erosion due to disease processes, such as actinomycosis, tuberculosis, or necrobacillosis, resulting in a complete destruction of portions of the esophageal walls and thus permitting the contents of the esophagus to infiltrate into the surrounding structures.

Perforation may also result from injury due to some foreign body that has been ingested and lodged in the esophagus. Weston reported the case, in *The American Veterinary Review* (Vol. 40, p. 658), of a hog that had swallowed a piece of sharp tin, which had perforated the thoracic portion of the esophagus. A sinus was formed in the adjacent lung, in which a small mass of food had accumulated.

Lesions.—The lesions resulting from perforation of the esophagus are quite variable and consist not only of the destruction of the

esophageal walls, but also of tissue changes induced by the escape of food from the esophagus into the surrounding tissues. In some instances the primary lesions consist of an inflammatory edema, while in other instances the primary lesions are tuberculous, actinomycotic, or necrobacillary.

Symptoms.—The symptoms resulting from esophageal perforation vary according to the secondary lesions evolved and the location of the perforation. Sharp objects may perforate and pass through the esophagus without permitting food stuff to pass through the perforation in the peri-esophageal tissue. In other instances food stuff may pass through the perforation into the surrounding tissue. Perforations in the thorax are much more serious than those occurring in the cervical region. The escape of food material from the esophagus into the surrounding tissue practically always produces a phlegmonous inflammation. If gas-forming bacteria are present then an emphysematous condition will be produced. Deglution will be difficult and in the majority of cases there will be aphagia. Perforation in the thoracic portion of the esophagus may be associated with vertigo, nausea, trembling and colicky pains.

Treatment.—The treatment of esophageal perforation depends upon removing the cause and healing the injuries, combined with proper diet.

ESOPHAGITIS

Esophagitis in hogs is not very common. It may be the result of injury from foreign bodies, exposure, infection or the ingestion of hot food or drink.

Catarrhal esophagitis is perhaps the most frequent type of inflammation and may be local or general. The usual lesions evidenced in the acute type consist of congestion, infiltration, and tumefaction of the mucous membrane, associated with desquamation of the epithelium. Ulceration may occur. The chronic type is characterized by an excessive development of fibrous tissue in the submucosa, causing the mucous membrane to be thrown into folds. Chronic esophagitis is occasionally observed in hogs that are fed exclusively on distillery slops.

Croupous esophagitis is usually the result of an invasion of streptococci, although this condition may be associated with hog cholera or pneumonia. The disease is characterized by the accumulation

upon the mucous membrane of a yellowish or brownish coagulated exudate.

Phlegmonous esophagitis is usually observed as a sequel of perforation, or the escape of pus into the submucosa from abscesses. This condition is sometimes associated with phlegmonous pharyngitis. The accumulated pus or other inflammatory exudate is frequently so extensive that the lumen of the esophagus is entirely closed.

The symptoms of inflammation of the esophagus are obscure. Difficult deglutition, nausea, vomition are the symptoms usually evidenced in swine affected with esophagitis.

Treatment of inflammation of the esophagus is not entirely satisfactory, because the affected animals will usually not attempt to swallow. If the condition is diagnosed in the early stages while the animal will drink slops, mucilaginous slops will be of value.

TUMORS

Tumors of the esophagus are relatively rare. Polypoid fibromas have been observed, and more rarely myxomas and myomas. Malignant tumors of the esophagus are quite rare, and when they do occur they are secondary.

Aberration of Appetite

(*Pig-Eating Sows*).

Pig-eating by sows is an aberration of the appetite or perversion of taste and is not attributed to any definite pathologic entity or condition. This condition may be a vice, an instinctive act, or a mania.

In some instances the cause of this depravity of appetite is improper feed during the latter portion of the period of gestation. It is always advisable to gradually change the feed of sows about two or three weeks before farrowing time, diminishing the fat-forming elements. Some feeders claim that adding small quantities of tankage to the feed for a period of ten days before farrowing will prevent this vice. The consensus of opinion is that a sow that has once formed the habit of eating her recently farrowed pigs cannot be broken of the habit, regardless of any variations of feeds and methods of feeding.

Stomach

MALFORMATIONS

Malformations of the stomach are comparatively rare in hogs. The stomach may be abnormally small and sometimes there is a constriction in the middle line producing the so-called hour-glass stomach.

FOREIGN BODIES

Foreign bodies in the stomach are comparatively frequent because hogs have a marked tendency to swallow objects of various kinds. The following was found in one hog's stomach:

40 nails.
15 staples.
4 screws.
4 nuts.
9 pebbles.
1 snap.
2 bolts.
1 brass pin.
1 piece porcelain.
1 No. 10 shotgun shell.
2 buggy-top tacks.
5 pieces of iron.
1 metal picture frame.
6 pieces of zinc.
8 pieces of wire.
1 piece of glass.
1 piece of brass.

Hair balls (trichobezoars) are occasionally observed in swine.

The damage due to foreign bodies in the stomach of swine depends upon their nature. Some sharp objects inflict wounds of various dimensions, and in some instances perforation occurs, succeeded by peritonitis.

Lesions.—The lesions vary with the nature of the foreign objects; in some cases only a catarrhal condition results, while in other instances there may be laceration or even perforation of the stomach walls.

Symptoms.—Evidences of gastric foreign bodies are by no means sufficiently distinct to differentiate this condition from various other gastric disorders.

Treatment.—Little is available in the way of treatment of swine that have ingested foreign bodies. Small objects may be expelled by vomition excited by emetics such as ipecac or apomorphine or they may be removed by gastric lavage. Objects embedded in the gastric walls can be removed only by surgical interference, but gastric surgery in swine is not well developed at this time.

Treatment to relieve vomition in swine is of questionable value because vomiting is nature's method of eliminating irritating substances from the stomach. The cause of the vomition should be determined and removed or overcome and the trouble will cease. If vomition is found to be caused by irritating substances in the stomach it may be advantageous to further stimulate this process of elimination by the administration of ipecac, syrup of squills or veratrine, the latter being injected intramuscularly in one-half grain doses. Cases of vomition resulting from constipation may be relieved by the use of purgatives. Salines are probably the most applicable purgative in relieving constipation in swine. Magnesium and sodium sulphate in from 2 to 4 ounce doses given in solution in capsules usually produce purgation in a few hours.

If vomiting is associated with gastritis, it is usually advisable to overcome the vomition by rectal injections of chloral or the administration of opium in capsules or by the injection of morphine. It may be necessary to use cold compresses in the pharyngeal region in addition to the administration of narcotics.

The presence of foreign bodies in the stomach is sometimes due to aberration of appetite and this variation of appetite frequently continues and constitutes an outstanding symptom. There is usually imperfect gastric digestion manifested by restlessness and in extreme cases by retching and vomition.

VOMITION (EMESIS)

Vomition is rather common in swine and is the result of stimulation of the vomition center, which is located in the medulla. This stimulation may be direct from irritation in the nerve center, but more frequently it is indirect from irritation of some portion of the gastro-intestinal tract. Vomition is therefore a symptom of a variety of disease conditions. It may be caused by engorgement of the stomach, nature having provided this method of relieving an overloaded stomach. Intestinal obstruction is another frequent cause of vomition in swine, as is also irritation of the mucosa of the esophagus, intestine, and more especially the stomach. Thus hog cholera is frequently evidenced by vomition. Gastric parasites not infrequently cause sufficient irritation to produce violent vomition, particularly in small pigs, while chemical irritants acting upon the digestive mucosa may produce vomition.

Swine as a rule vomit easily. The affected animals become un-

easy and restless. They extend the head and depress the nose, the esophageal muscles relax, the abdominal muscles contract, and the stomach content is thus forced out. The vomited material usually consists of particles of food admixed with mucus, although it may be composed entirely of a thin, shiny mucus. The expelled material may contain intestinal as well as gastric contents.

ANEMIA

Anemia of the mucous membrance of the stomach occurs in swine after surgical operations in which large quantities of blood have been lost. It may also be due to obstruction of the arteries supplying the gastric walls.

A long-continued anemia of the stomach results in atrophy of its walls. An anemic stomach is pale, flabby, and bloodless.

Gastric anemia results in improper digestion, which ultimately leads to emaciation and possibly to other disturbances of the animal body.

HEMORRHAGE (HEMATEMESIS)

Etiology.—Hemorrhage of the stomach, or hematemesis is the result of erosion of blood-vessels due to diseased processes, traumatisms, and caustics. Hog cholera is the most frequent cause of gastric hemorrhages in hogs.

Petechial hemorrhage into the walls of the stomach is associated with various infective diseases.

Lesions.—Erosion or laceration of the blood-vessels plus an accumulation of blood in the stomach or discharged from the stomach, are associated with gastric hemorrhage. The hydrochloric acid of the gastric juice, acting upon the blood, forms a clot, and also changes the color of the blood. As a rule the extravasation is converted into masses, which are of about the same size and color as roasted coffee beans. If the escaped blood from the stomach passes on through the intestine it will remain firmly clotted in coffee-bean masses. These masses characterize gastric hemorrhage and serve to distinguish gastric from intestinal hemorrhage.

Symptoms.—Gastric hemorrhage is evidenced by a pale mucous membrane and the escape of non-frothy, black, and more or less coagulated masses of blood from the mouth.

If the blood escapes slowly it may not be eliminated by vomition, and the evidence of the hemorrhage will be found in the feces. The

acid gastric juice causes a coagulation of the blood and converts it into a brown color which forms in masses about the size of grains of coffee, and may be observed in the feces. The coffee-grain coagula in the feces are characteristic of gastric hemorrhage.

Treatment.—The treatment for gastric hemorrhage depends upon the cause of the condition. In cases in which vomition is a prominent symptom, antemetics should be administered. Lime water, one-half dram doses of milk of magnesia, insoluble bismuth salts in one-half-dram doses or chloral hydrate in dram doses, administered in capsules are useful in overcoming nausea and vomition. If the hematemesis is the result of perforation or laceration of the gastric walls, the administration of bismuth subnitrate in half-dram doses serves the double purpose of an antemetic and hemostatic.

PEPTIC ULCERS

Peptic ulcers are rarely observed in swine, but when they occur are usually near the pyloric end of the stomach.

Etiology.—The cause of peptic ulcer is thought by some to be due to thrombotic formation; it may be due to the action of gastric juice upon anemic areas of the stomach.

Lesions.—Peptic ulcers are characteristic in their appearance. They may involve the mucous membrance only or they may extend through the submucosa and involve the muscular coat of the stomach, and even perforate the serous membrane. In size they vary from that of the cross-section of a lead pencil to the area of a silver dollar. They appear as though made by means of a punch, and if they involve more than the mucous membrance they usually have a terraced margin; their walls being clean-cut and non-inflammatory.

Symptoms.—The evidences of peptic ulcer vary, but usually there is indigestion and occasionally hemorrhages. Sometimes it results in perforation of the stomach, followed by peritonitis and death.

Treatment.—The treatment of peptic ulcers, if the diagnosis should be made, is not satisfactory. The administration of one-half-dram doses of 1 per cent solution of silver nitrate has been advised but has been attended with little success when administered to cases known to be affected with ulcers of the stomach. In many instances gastric hemorrhage is the result of peptic ulcers, and such cases are frequently relieved, at least temporarily, by the administration of bismuth subnitrate once daily. The feed should be carefully regulated in these cases. Special precautions should be taken to pre-

vent over-feeding and most such patients will respond to treatment much more readily on one-half or two-thirds of the regular ration.

HYPEREMIA

Passive hyperemia of the stomach is the result of obstructive circulation and usually is evidenced by more or less edema of the gastric walls; in extreme cases there may be thrombotic formation and focal or even extensive necrosis.

Active hyperemia of the stomach is much more common than the passive form, and may be either physiologic or pathologic.

Pathologic gastric arterial hyperemia is caused by irritation, either from chemicals, undue exposure, or infection, and represents the primary stage of inflammation.

Hyperemia of the stomach is rarely diagnosed as such. It is difficult to draw a line between physiologic and pathologic hyperemia, and unfortunately it is not possible to distinguish between pathologic active hyperemia and inflammation of the stomach. If such a distinction could be made the inflammatory process could in the majority of cases be prevented.

GASTRITIS

Gastritis is relatively common in hogs. It results from traumatic injuries, chemical irritants (poisons), and infection.

Catarrhal Gastritis

Catarrhal gastritis is of fairly common occurrence and usually results from mild irritation. It is evidenced by a hyperemia of the mucosa, which appears red, slightly tumefied, and covered with varying quantities of mucus.

Etiology.—The most common causes of catarrhal gastritis are improper feed and irregular feeding. Moldy, musty, sprouted, burned and immature grains are frequently fed to swine, and are not only responsible for many cases of indigestion but also other diseased conditions. The hog is usually considered as the farm scavenger and any food stuff that is deteriorated is ordinarily considered good enough for swine. Some breeders and feeders cook the food stuff for swine and occasionally such feeds are given sufficiently hot to cause irritation not only of the buccal mucosa but

also of the gastric mucosa. Irregularity of feeding is another important factor in the production of gastric catarrh and the associated indigestion. The stomach like any other organ adapts iself to certain habits, such as a fixed time for feeding. If swine are fed at a certain hour each morning and evening, the digestion will be much more perfect than if fed at irregular periods and, therefore, it is economy to have a fixed feeding time. If animals are not fed until after the regular feeding time they are likely to overload, due to the fact that they were hungry, and consume the food more rapidly than when fed regularly. Overloading is a factor in the production of gastric catarrh. Drinking of large

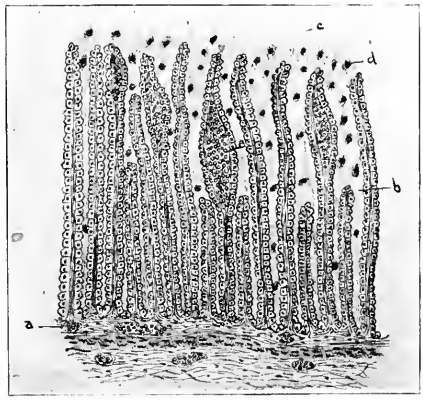


Fig. 22. ACUTE GASTRITIS, a, Congested vessel in stroma; b. Gastric crypt and glands; c, mucous exudate; d. Migratory leucocyte.

quantities of cold water may produce catarrh of the stomach. Gastritis is frequently associated with infectious diseases such as hog cholera and necrotic enteritis.

Symptoms.—The symptoms of catarrhal gastritis vary according to the intensity of the disease, vomition after eating being one of the most common. There is usually increased thirst. In the beginning of the disease there is often constipation, followed by diarrhea with a discharge of a thin, fetid, fecal material. There is a slight rise of temperature and usually an unequal distribution of surface temperature, one part being warm while another is cold. The tail drops, and the animals have a tendency to pile up or get under their bedding. The course of the disease is usually rapid and recovery almost certain.

Treatment.—The treatment consists in determining the cause and then removing it. It is advisable to empty the stomach by use of an emetic, such as apomorphin. Mild laxatives or laxative foods should be given. The affected animals should then be placed on a diet consisting of a small quantity of easily digested food. Further treatment is rarely necessary.

Croupous Gastritis

Croupous gastritis is usually the result of caustics ingested with food stuff, such as lye, which is occasionally fed in large quantities for the purpose of warding off diseases of various kinds.

Lesions.—In croupous gastritis an intense tumefaction of the mucosa is present, the affected portion containing accumulation of exudate which is dirty white or brown in color, and when detached usually leaves a bleeding surface.

Symptoms.—The manifestations of croupous gastritis are similar to those of catarrhal gastritis, but are more intense. The animals evince gastric pain by uneasiness, restlessness, and frequent vomition. There is a rise of temperature of from one to two degrees Fahrenheit. The affected swine have little desire to eat, but they show a tendency to drink frequently, after which they evidence more intense pain until they vomit. The tail hangs straight, and the animals have little tendency to move.

This disease usually runs a rapid course, as a rule terminating within five to eight days.

The prognosis should be guarded.

Treatment.—The treatment consists in giving demulcent drinks, such as flax-seed gruel after having removed the cause. The content of the bowels should be kept soft by laxatives. The affected animals should be separated from the healthy and given good quarters.

Phlegmonous Gastritis

Phlegmonous gastritis occasionally occurs in hogs and is usually the result of infection with streptococcic microorganisms.

Lesions.—The anatomical changes occurring in phlegmonous gastritis consist of an intense tumefaction of the mucosa due to accumulation of pus or other inflammatory products in the submucosa. Patches of the mucosa may become necrotic and desquamate. In other instances large sinuous tracts are formed beneath the mucosa

and in these pus accumulates in large quantities. The muscular layers of the stomach frequently become infiltrated with pus; the inflammatory process may extend to and involve the serous coat.

Symptoms.—The evidences of phlegmonous gastritis are not distinct and separable from those of croupous gastritis. There is usually intense pain, indicated by the constant change in position of the animals. Vomition is usually frequent, the vomited material being small in quantity and largely mucous or mucopurulent in character, and it is not infrequently mixed with blood. There is inappetence, thirst, and a drawn-up appearance of the abdomen, with arching of the back. The temperature ranges from 104 to 107 degrees Fahrenheit. Constipation is usually quite marked in the beginning, but may be succeeded by diarrhea.

The course of this disease varies from three to seven days. The prognosis should be guarded, as the disease is usually fatal.

Treatment.—The pain may be relieved by the administration of a demulcent. Flax-seed tea or gruel will usually be consumed if it is the only available fluid for drinking. If the pain is not relieved by the demulcent drink, one-half-dram doses of chloral hydrate should be administered in a capsule. In cases evidencing constipation enemas will be found of value. In valuable animals gastric lavage may be resorted to.

Chronic Gastritis

Chronic gastritis is of rather frequent occurrence in hogs.

Etiology.—Chronic gastritis is caused by the long continued action of mild irritants. Thus, the constant feeding with improper feed is a very common cause of chronic gastritis. Some feeders claim that a constant corn ration may produce sufficient disturbance to result in chronic gastritis. Garbage, especially if no precautions are taken to prevent the feeding of putrid or fermented substances, will cause chronic gastritis. Parasitism may cause chronic gastritis. The most common offending parasite is the ardnenna strongylina.

Lesions.—The anatomical changes in the stomach consist of a fibrous proliferation which may destroy the gland tissues or obstruct their ducts, resulting in the formation of small cysts. The mucosa is usually attenuated, due to atrophy of the mucous membrane. As a rule there is some ulceration and not infrequently the capacity

of the stomach is diminished, due to the contraction of the newly formed fibrous tissues.

Symptoms.—The symptoms of chronic gastritis of swine are not distinct. There is variation of appetite. Vomition immediately after eating may or may not be present. Affected animals are unthrifty as a result of nutritive disturbances.

It is not uncommon to see affected animals actually diminish in weight. This is particularly true in cases in which there is diarrhea. Chronic gastritis in swine is similar to dyspepsia in the human.

This is essentially a chronic disease, the courses varying from a few weeks to months. Prognosis is favorable as to the life of the animal, but unfavorable as to the relief of the condition.

Treatment.—Treatment consists in strictly limiting the diet to easily digested foods, and the maintenance of a laxative condition of the bowels.

If the appetite is irregular and the animals appear to have little desire for food the administration of a bitter tonic will be found of value, such as gentian and nux vomica, which may be administered in their feed or by capsules.

DILATATION

Dilatation of the stomach may be acute or chronic.

Acute Gastric Dilatation

Acute dilatation is a condition resulting from a rapid distention of the stomach, a condition not very common in swine.

Etiology.—Acute dilatation is usually due to overloading the stomach. It is most frequently caused by the ingestion of large quantities of indigestible substances, or of foods that are easily and extensively fermentable.

Lesions.—The lesions observed in acute dilatation consist of enlargement, the walls being very much attenuated. Rupture of the stomach may occur in the greater curvature.

Symptoms.—The evidences of acute dilatation are the same as those of overloading of the stomach. Restlessness, succeeded by vomiting, is the usual sign observed in the early stages of a limited dilatation. In some instances the walls of the stomach become so thin due to extreme distention, that vomition is not possible, and such cases are evidenced by gagging, salivation, and bloating, if the distention

is due to foods that readily ferment. Extreme distention produces distress and expressions of pain.

Diagnosis.—Diagnosis of gastric dilatation is dependent upon history and the symptoms indicated above. Prognosis should be guarded, as the possibility of rupture must always be considered.

Treatment.—When the dilatation is not too great, the treatment should be largely confined to removal of the gastric content by emetics, and to lavage when the dilatation is extensive and likely to result in rupture.

Chronic Gastric Dilatation

Chronic gastric dilatation is not common in swine but has been observed. Accumulation of indigestible substances is the usual cause of the trouble. Occasional cases have been observed where there was sufficient accumulation of hair in the stomach to permanently dilate it beyond the normal capacity.

Symptoms.—The usual evidences of chronic gastric dilatation consist of irregular appetite, associated with unthriftiness. The stomach is distended, and may contain various foreign bodies or indigestible substances. The gastric mucosa is usually affected with chronic catarrh.

Treatment.—This condition is not very successfully treated because of the tendency to permanent dilatation of the stomach. Dieting, especially with easily digestible, concentrated foods, is especially advised.

TUMORS

Tumors of the stomach of swine are not very prevalent, or at least such cases are rarely reported.

Fibromas have been observed in only a few instances. They usually involve the serous coat and rarely become of sufficient magnitude to cause damage other than slight mechanical interference. These tumors are invariably incapsulated, and appear as a dense, fibrous mass.

Lipomas occur in the serous coat of the stomach of swine though they are not common. A few such tumors have been observed, and in one instance the tumor had become so large that it seriously interfered with the function of the organ by displacing the stomach and producing such pressure that it practically occluded the

duodenum and resulted in death. Lipomas appear as more or less nodular masses, and are invariably incapsulated.

Of the malignant tumors, carcinoma and adenoma have been observed, although they too are rather infrequent and do not appear to be so injurious to the health of swine as the same kinds of tumors are to horses or even to cattle. Carcinomas may develop in the submucosa and project into the lumen of the intestine as a cauliflower-like mass, or they may develop in the mucosa, producing erosions not only of the mucous membrane, but of the other structures of the stomach wall, ultimately causing perforation and fatal peritonitis. These tumors are not incapsulated.

The symptoms evolved as a result of tumors are quite variable and not sufficiently characteristic to permit a positive antemortem diagnosis.

The treatment of gastric tumors is entirely surgical.

PARASITES

Arduenna strongylina is a very common parasite in the stomach of swine. In the central United States it is probable that at least ninety per cent of swine are infested. They are small-thread like, white worms, varying in length from three-fourths of an inch to one and one-half inches, usually more or less coiled, although they may be found practically straight. They may be found in masses in the submucosa, free upon the mucous membrane, extending into the gastric glands, or even perforating the mucous membrane. They injure their host by direct abstraction of nutriment, by obstruction of gastric glands, by destruction of tissue, and by irritation. The usual condition resulting from infestation with these parasites is chronic gastric catarrh.

Symptoms.—Symptomatically the infestion with large numbers of the Arduenna strongylina is evidenced by variation of appetite, and usually by constipation, unthriftiness, and rough coat. It is doubtful if any symptoms would be sufficiently prominent upon which to base a diagnosis in cases in which the infestation is limited to a few worms.

Treatment.—Treatment of gastric parasitism is not difficult providing the parasites are free upon the surface, but successful treatment is difficult in cases where the parasites have passed through the mucous membrane into the submucosa. The usual anthelmintic

treatment is most easily applied in the food or slop. Ferrous sulphate, copper sulphate, or oil of turpentine may be mixed with slops. Santonin given with food is of value, but creosote in the slop is probably most efficient.

The Simondsia paradoxa infests the stomach of swine, but is probably not found in the United States, although quite prevalent in some sections of Europe. The lesions, symptoms, and treatment are similar to those given for Arduenna strongylina.

Ascaris suum is found occasionally in the stomach, but its natural habitat is the intestine, and it will be discussed latter in that relation.

Intestines

MALFORMATIONS

Total absence of the intestine is rare and occurs practically only in acardiac monsters.

Atresia ani, that is, the failure of development of the anus, is relatively common. This condition results from the failure of invagination of the skin surface which normally extends to and fuses with the rectum. Pigs so affected, unless the defect is relieved by operation, die the first or second day after being farrowed. The defect is as a rule easily corrected by operation in which crucial incisions are made through the skin and terminal end of the rectum, the skin and rectal triangular flaps being interdigitated and maintained by sutures.

Cloacal formation in which there is a common opening for the intestine, uterus, and vagina or ureters sometimes occurs, but this is not a serious defect, except in breeding animals.

Diverticula are not rare. They are usually the persistent remnants of the vitellin or omphalomesenteric duct. They do not as a rule interfere with the health of the animal.

Transposition, particularly of the large colon, may occur, but is not of any significance except as a pathologic condition.

Congenital hernia may occur. The outcome depends upon the extent and nature of the defect.

HEMORRHAGE (ENTERORRHAGIA)

Enterorrhagia occurs rather commonly in swine.

Etiology.—Mechanical injury of the structure of the intestine by

ingested foreign bodies is a common cause of hemorrhage. In extreme cases of constipation the accumulated fecal matter may become so desiccated that it readily produces abrasions of the intestinal mucosa, resulting in hemorrhage. Parasites, particularly the Gigantorhynchus hirudinaceus, may also produce hemorrhage. In-

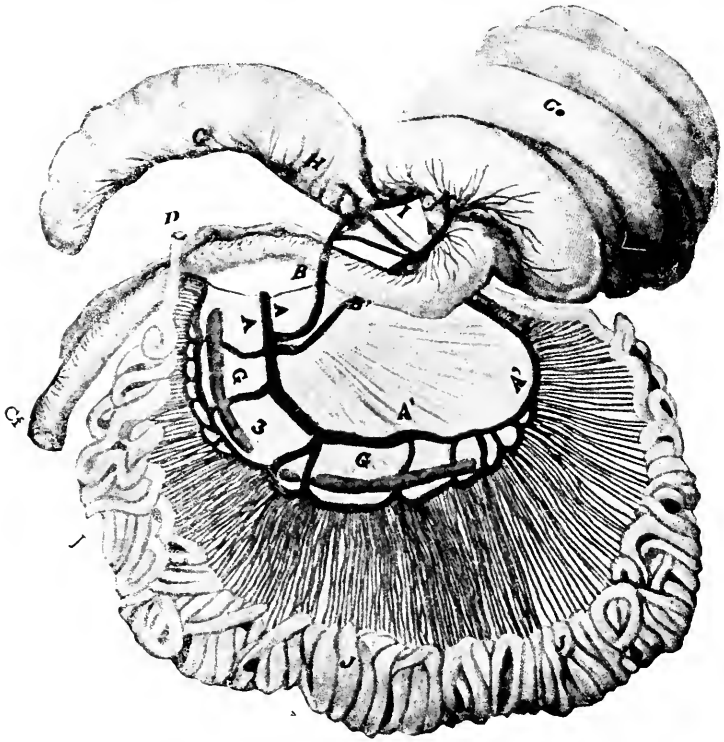


Fig. 23. Arteries and lymph glands in the intestines of the hog. A, Great mesenteric artery; A^1, arteries of the intestinal mesentery and its subdivisions; J, small intestine; C, cecum; Co, colon; G, mesenteric lymph glands forming a chain along the vascular arches of the mesentery; H, group of lymph-nodes along the course of the cecal artery; K, several small lymph-nodes on the colic artery. (From Aureggio's "Album Guide.")

testinal hemorrhage is a common symptom of hog cholera, anthrax, septicemia, cryptogamic poisoning, caustic poisoning, and severe inflammatory disturbances of the intestine.

Lesions.—The particular lesion identifying intestinal hemorrhage is the extravasated blood which may or may not be thoroughly

admixed with the intestinal content. If the hemorrhage has been extensive there will be a general anemia of the entire mucosa. Lesions of the intestinal mucosa will be observed in those cases in which the hemorrhage has been induced by trauma or chemical irritants. There may be no evidence of intestinal mucous membrane lesions in the infective diseases like hog cholera, as the hemorrhages in these cases are usually the result of blood-vessel lesions rather than mucosa lesions.

Symptoms.—The first evidence of intestinal hemorrhage is the passing of the blood from the anus. If the discharged blood is thoroughly admixed with the feces and of a brownish cast it indicates that the hemorrhage has been well forward in the small intestine. If the discharged blood occurs in masses, not mixed with the fecal matter, and has the normal blood color, it indicates that the hemorrhage has been in the anterior portion of the large intestine; and if the fecal matter is streaked with blood on the outer surface only, the hemorrhage occurred in the rectum. The visible mucous membranes will be pale, pulse rapid and almost imperceptible, and there will be weakness associated with uncertain gait.

Diagnosis.—The diagnosis of enterorrhagia is usually not difficult, although it may not be an easy matter to determine the exact cause of the condition. In gastric hemorrhage the extravasated blood that passes through the bowel is granular and of a black color; the extravasate from intestinal hemorrhage is massive, occurs upon the surface of the feces, and is normal in color.

Treatment.—The treatment of intestinal hemorrhage is problematic, and the relief from this condition is dependent upon removing the cause, which is not always possible. The effected animals should be kept quiet. Ergot may be used to advantage. Astringents combined with laudanum may produce the desired results.

OBSTRUCTION

Intestinal obstruction is a condition resulting from the occlusion of the intestine by foreign bodies, inspissated fecal material, parasites, abscesses, tumors, cicatrices, rotation of the intestine upon itself or volvulus, and invagination or intussusception. Intussusception is not as common in the hog as in some other animals because of the arrangement of the mesentery, although it may, and sometimes does, occur.

Lesions.—The anatomical changes observed in intestinal obstruction vary according to the cause and duration of the condition. Thus foreign bodies, such as hair balls or nails, may be found; a tangled mass of Ascaris suum is sometimes the only lesion; abscess, tumor formation, or changed relation of the intestine may be the principal lesion. Aside from the obstructing agent there may be inflammatory or necrotic lesions of the mucous membrane or other portions of the intestine.

Symptoms.—The first evidence is inappetence and a tucked abdomen, followed by infrequent defecation with the passage of small quantities of mucous-covered feces. Frequent attempts at defecation without the voiding of any fecal matter may occur. Vomition is a common symptom in the later stages. In some cases there is fermentation of the intestinal content with an excessive accumulation of gas, producing tympany.

Treatment.—The relief of intestinal obstruction depends upon the cause. Obstruction from inspissated fecal matter may be overcome by the judicious use of saline laxatives or enemas. Parasitic obstruction may be overcome by the use of vermifuges given orally or in enemas. Relief from obstruction due to tumors or abscess formation may be temporarily obtained by purgatives, but permanent relief is obtained only by removing the cause. The treatment for obstruction from volvulus or intussusception is problematic and the outcome by no means certain. Surgical operation may be resorted to in overcoming these conditions, as well as in foreign-body obstruction. If the accumulations of gas cause alarming symptoms, the trocar may be used to produce immediate relief, and further fermentation may be checked by the administration of antiferments, either through the cannula or per os. As soon as the animals have a desire to eat they should be given sparingly of easily digested liquid foods.

DILATATION

Intestinal dilatation is not of common occurrence in swine.

Etiology.—The usual cause is partial obstruction, resulting in excessive accumulations of food which produce atony and later a relaxation and dilatation of the intestinal walls. Should the dilatation be unequal, diverticular dilatation results.

Lesions.—The usual lesions observed in intestinal dilatation consist of distended intestine with an accumulation of excessive quan-

tities of food material in it and usually an associated condition that produces the primary obstruction.

Symptoms.—Symptomatically, the dilatation is not positively differentiated antemortem from obstruction, the symptoms of both conditions being practically identical.

Treatment.—In cases of dilatation, remove that which primarily causes an obstruction and then administer tonics to facilitate the return of intestinal tonicity.

EMPHYSEMA

Single air cysts or clusters of air cysts are not of infrequent occurrence, involving and protruding the serous coat of the intestine. This condition appears to produce no inconvenience and is of no particular economic importance. It has been thought to be the result of bacteria, probably of the colon group, which have penetrated through the intestinal wall to the serous coat, where they produce fermentation and the gas evolved is accumulated beneath the serous membrane. These air cysts vary in size from a pinhead to a pea, and there may be only a limited number of them or myriads. Occasionally they are so prevalent that the intestine will float on water.

This condition is of no practical consequence, as the flesh from an animal in which this condition occurs is not damaged and is wholesome for human consumption.

ENTERITIS

Enteritis is inflammation of the intestine and may be catarrhal, croupous, diphtheritic, mycotic; simple or infective, acute or chronic.

Catarrhal enteritis may be either acute or chronic.

Acute Catarrhal Enteritis

Acute catarrhal enteritis is a common ailment of swine.

Etiology.—The usual cause of this disease is improper food. The natural habits of swine are conducive to the introduction of various microbes into their food and drink, and swine are frequently fed on materials that are partially decomposed. Their food not infrequently contains chemical substances that are sufficiently irritating to establish a catarrhal gastritis and enteritis. The ingestion of foods of extreme temperatures may excite catarrhal enteritis; not

infrequently parasites occur in sufficient numbers to produce local irritation of sufficient extent to result in catarrhal enteritis; finally, acute catarrhal enteritis may be associated with a variety of infective diseases.

Lesions.—The lesions may be localized or they may be general, involving practically the entire intestinal mucosa. In the beginning the affected mucous membrane is red, tumefied, and rather dry, but later it becomes coated with mucous which is produced in excessive quantities as the disease progresses. The submucosa may be swollen, due to the accumulation of inflammatory exudate. The tumefaction of the mucosa sometimes effectually closes the ducts of the intestinal glands, thus forming retention cysts, and the villi are turgescent and have a velvety appearance. The lymphoid tissue

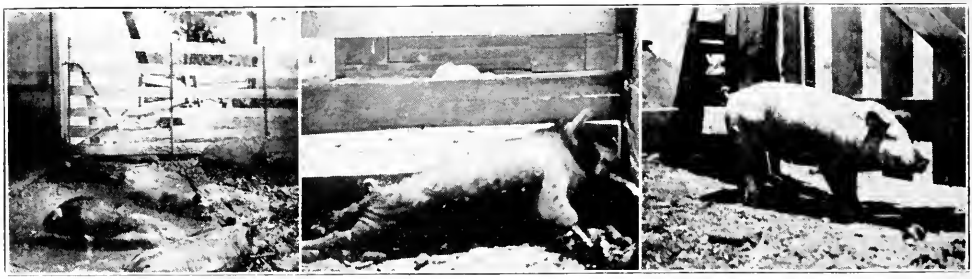


Fig. 24. The mud wallow is a prolific source of infection. The hogs in this wallow were affected with enteritis. The one in the center had tetanic spasms. Note how it went down in the back. The pig at the right could scarcely walk because of tetanic spasms. (Photo by Keehn.)

usually becomes swollen and contains excessive quantities of leukocytes which may be expressed as a milky substance. There may, in the advanced stages, be areas of necrosis of the epithelium of the mucous membrane. In the submucosa, hemorrhages of varying size may occur.

Symptoms.—Acute catarrhal enteritis occurs most frequently in connection with acute catarrhal gastritis, and the symptoms of gastritis usually overshadow those of enteritis. Inappetence or variation of appetite, rise of temperature, listlessness, and arched back are common symptoms of acute gastrointestinal catarrh. The symptoms of acute intestinal catarrh are frequent defecation of small quantities of mucous-coated feces. In the beginning, there is usually

constipation, but this condition is succeeded by diarrhea. The affected animals groan and roll frequently.

Treatment.—Remove the cause. Administer calomel in 5 to 20-grain doses to clear the intestine of all offending material. If constipation is marked, use saline enemas prior to the administration of calomel. Give a limited amount of easily digestible foods and have them fed at regularly stated intervals.

Chronic Catarrhal Enteritis

Chronic intestinal catarrh is usually a sequel of acute intestinal catarrh.

Etiology.—The usual causes of chronic intestinal catarrh are the same as those causing acute intestinal catarrh, but are continued over a longer period of time and probably, in the majority of instances, are not so intense. Error of diet is the most frequent cause. Chronic heart or liver diseases that produce venous engorgement of the intestine are common causes. Parasites, no doubt, are responsible for an occasional case of chronic intestinal catarrh.

Lesions.—The affected mucous membrane is usually of a uniform or mottled bluish, steel, slate color. The mucosa is tumefied, dense, and of a leathery consistency due to the excessive development of fibrous tissue in the submucosa. Small retention cysts representing occluded glands may be present. The covering epithelium of the mucous membrane is attenuated and sometimes erosions, or even ulcerations, are observed.

Symptoms.—Irregular appetite, alternation of constipation and diarrhea, rough coat, emaciation, and malnutrition characterize chronic intestinal catarrh. The foregoing symptoms tend to persist, as the disease may continue for weeks.

Treatment.—A proper diet combined with good surroundings are prerequisites for the successful treatment of cases of chronic intestinal catarrh. Regulation of the bowels, with maintenance of the proper consistency of the fecal matter, is highly important.

In these cases it is usually advisable to administer calomel in 5-20 grain doses, followed in 24 hours by from one-half to one ounce of castor oil, given in capsules. Bitter tonics containing gentian, nux vomica or desiccated iron should be given in the feed, unless there is anorexia, when it should be given in capsules. Treatment must be persistent, as success will be attained only by a long-continued course of treatment, combined with the proper diet.

Croupous Enteritis

Croupous enteritis occurs in swine but is uncommon.

Etiology.—Croupous enteritis may be the result of infection but probably is more frequently caused by chemicals. Caustics or acids may be protected by food within the stomach to be liberated in the intestine where an intense inflammation would be established.

Lesions.—The lesions of croupous enteritis consist primarily of an intense inflammation in which there is a coagulated inflammatory exudate adherent to the surface of the involved mucosa. The intestinal wall will be found thicker and more dense than normal, due to the inflammatory exudate in the submucosa and possibly also in the muscular tissue. In the later stages the surface exudate may become detached *en masse* and pass out with the feces. If the entire mucosa is involved for some distance the eliminated exudate may appear as a tube.

Symptoms.—Uneasiness, colicky pains, drooping ears and tail, increased thirst, inappetence and rise of temperature are the usual manifestations of croupous enteritis.

Diagnosis.—The history of the case combined with the symptoms previously noted is sufficient evidence to establish a diagnosis of inflammation of the intestine. The absence of retching or vomition excludes gastritis. The specific diagnosis of croupous enteritis is possible only upon autopsy or the recognition of the croupous exudate in the feces.

Course.—The course of croupous enteritis is rapid, the disease being acute.

Prognosis.—The prognosis should be guarded, if the animal survives for two or three days the chances for recovery are good.

Treatment.—Remove the cause if it still exists. Withhold all foods for 24 hours and then give only limited quantities of easily digested concentrates in the form of slop. Substitute flax-seed tea for water from the beginning. Intestinal antiseptics should be incorporated in the flax-seed tea, and stimulants such as nux vomica may also be given in the slop.

Infectious Necrotic Enteritis

This disease is of an infectious nature and is of such importance that it is described in detail in the chapter on infectious diseases.

Toxic Gastritis, Gastro-Enteritis, Enteritis

A variety of conditions have been grouped under this heading, but this number fortunately is becoming less as more exact investigations are being concluded. It is difficult to clearly distinguish between toxic gastric, toxic gastro-intestinal, and toxic intestinal conditions, and as a matter of common observation it has been found that substances that ordinarily produce toxic gastritis have not spent their entire force in the stomach, and thus continue their action in the intestines. On the other hand, few if any substances are toxic in the intestine that are not also toxic in the stomach. It is convenient to discuss these conditions under poisoning.

POISONING

Sodium Chlorid (Common Salt)

Posioning from common salt is rather common. Swine may obtain salt in cattle yards, or it may be incorporated in garbage. Meat brine is a frequent source of salt poisoning and is very destructive, as, unfortunately, swine appear to relish it. Brine poisoning is not only due to the contained salt, but also to other ingredients. Poisoning by herring brine produces, in addition to toxic gastro-enteritis, cerebral disturbances very similar to ptomaine poisoning. It has been found that from two to eight ounces of salt produce poisoning in swine, and in some instances much smaller quantities are fatal.

Lesions.—Sodium chlorid is an intense gastro-intestinal irritant, particularly when in a concentrated solution. In the beginning the mucous membrane of the stomach will be intensely congested. This is followed by hemorrhages upon the mucous membrane, and inflammatory disturbances. If absorption is retarded the stomach and bowel content will contain large quantities of blood. The mucous membrane of the bladder will be engorged, and similar lesions may be observed in the meninges.

Symptoms.—Intense thirst, inappetence, restlessness, and vomition are usually the first symptoms evidenced. Later there will be watery diarrhea, frequent urination, depressed heart action, muscular weakness, and paralysis. The animals may die within five or six hours after ingesting the salt, or they may not die until the second or third day; if the quantity consumed has been small, they may survive.

Treatment.—Emetics should be employed if the animals are observed immediately after consuming the salt. The most applicable emetic is apomorphin which may be injected intramuscularly in one-half grain doses, repeating in 30 minutes if the desired results are not obtained. Syrup of squill in half-ounce doses or ipecacuanha may be used and should be given in capsules. In cases of several hours' standing, mucilaginous drinks and rectal injections should be given. Oleaginous purgatives, such as castor oil or raw linseed oil, are of value as eliminants. Castor oil is preferable as a smaller dosage is required. It should be given in capsules. Strychnin should be injected intramuscularly in 1/60 grain doses to overcome the cardiac depression.

Caustic Potash, Caustic Soda (Lye; Washing Powders)

It is a common practice to feed swine wash water, particularly water that has been used for washing dishes and in which liberal quantities of washing powder or lye have been used. Some swine breeders and feeders add varying quantities of lye to the feed to "ward off disease."

Lesions.—Caustic alkalies may produce congestion, inflammation, or necrosis, depending upon the concentration of the mixture. The lesions will be diffuse if the alkali has been in solution; they will tend to localization if the alkali has been in the powdered form. In the latter case the lesions occur where the alkali granules have been deposited upon the mucous membrane. The lesions are usually more intense in the stomach than in the intestine.

Symptoms.—Retching, vomition, restlessness, and muscular weakness are the usual symptoms evidenced in the beginning, followed later by diarrhea, incoördination, and paralysis. Death may occur within a few hours or in two or three days. Some of the affected animals may recover.

Treatment.—In the early stages emetics should be given until vomition is produced. Later acidulated water and oleaginous purgatives will be of value.

Phosphorus

In some sections of the country phosphorous compounds are used in destroying gophers, squirrels, and other similar animals, and not infrequently swine obtain a sufficient quantity of the poison to produce grave disturbances and even death.

Lesions.—The buccal, pharyngeal, gastric, and intestinal mucosa show inflammation. The liver and kidneys are enlarged, due to fatty degeneration of their parenchyma, and the heart also is usually affected by fatty changes. The content of stomach and bowel are phosphorescent when examined in the dark, and a distinct phosphorous odor emanates from the stomach and bowel when these organs are opened.

Symptoms.—Intense thirst, difficult deglutition, vomition, and colicky pains, associated with weakness and incoördination, are produced by phosphorous poisoning.

Treatment.—Emetics and the administration of turpentine in mucilaginous substances, when applied energetically, will sometimes save the patient.

Phenol (Carbolic Acid)

Phenol and various compounds containing phenol or crude carbolic acid are extensively employed on many stock farms as the essential ingredient in dips and they are also used for disinfection. Quantities of such agents may be obtained by swine in wallow holes, in contaminated troughs and in feeds. If such waste products contain sufficient phenol and they are consumed by swine, poisoning may follow.

Lesions.—The mucous membranes of the digestive tube but especially of the mouth and stomach will be destroyed and the mucosa may still be intact and appear as a gray or white membrane. The submucosa beneath the areas of destroyed mucosa will be congested and hemorrhagic. If sufficient has been consumed to destroy life there will be nephritis, bloody urine, and congestion of the liver.

Symptoms.—Salivation, vomition, colicky pains, muscular weakness, and the urine will be dark in color and have a peculiar odor.

Treatment.—The administration of a rapidly acting emetic such as one-half-grain doses of apomorphin. The mouth should be swabbed with alcohol. Purgatives are indicated, particularly the salines, such as epsom salts, using large doses.

Bichlorid of Mercury (Corrosive Sublimate)

Bichlorid of mercury is frequently used in the disinfection of farm buildings and equipment and sufficient quantities may be obtained by swine to produce poisoning. Commercial calomel may contain varying quantities of corrosive sublimate and the use of

such impure calomel in the preparation of specialties or when prescribed as such is likely to be followed by serious results. Several instances have been reported of losses of swine due to corrosive sublimate poisoning where the animals had been medicated with vermifuge capsules containing commercial calomel.

Lesions.—The lesions produced by bichlorid of mercury consist of an intense inflammation of the mucosa and intestine. The distance the lesions extend in the intestine will depend upon the quantity of the bichlorid consumed. The inflamed areas will be red and there may be hemorrhagic areas due to the erosive action of the drug. If large quantities of the poison are consumed, there may be erosion of the entire stomach wall, thus producing perforation.

Symptoms.—The symptoms evidenced are colicky pains, vomition, purgation, trembling and muscular weakness. If there has been perforation, symptoms of peritonitis will develop, but the animal usually succumbs before peritonitis is well established.

Treatment.—Prevent further posioning by removing the cause. If the affected animals have recently developed the symptoms, an effective emetic should be given at once. Apomorphin in one-fourth-grain doses given intramuscularly, or ipecac given in a capsule usually produces vomition promptly. When the stomach has been emptied by vomition, albuminous drinks should be given for they will not only soothe the irritated mucosa but also will cause the formation of an insoluble albuminate of mercury, thus rendering the corrosive sublimate inert. Sweet milk or the white of egg are suitable for this purpose.

If the animals have been affected for several hours, emetics are not indicated, for the bichlorid will have exerted its action in the stomach and the portion of the drug that has passed into the intestine cannot be eliminated by an emetic. Such cases should be given albuminous drinks at once and a purgative, preferably epsom salts, should be administered. Potassium iodid in 10-15 grain doses given every three hours will be found of value in overcoming the after-effects of the poison. Stimulants should be used if there is muscular weakness.

Xanthium Canadense (*Cocklebur*)

Cocklebur poisoning prevails more or less extensively in the Missouri Valley during the early spring months. Just as the two cotyledons push through the ground is the only time in the development

of the cocklebur that it is poisonous, or possibly swine eat the plant only during this stage of development. The writer assisted in an investigation of the effect of young cocklebur when eaten by swine at the Kansas Agricultural Experiment Station in 1899. Quantities of the young plants were gathered and fed to pigs weighing from forty to sixty pounds. The symptoms, although not universally the same in all cases, clearly indicated a gastro-enteritis, which was verified by autopsy.

Lesions.—There is evidence of a marked gastro-enteritis in animals dead of cocklebur poisoning, usually involving the entire mucosa of the stomach and the small intestine and not infrequently extending to the mucous membrane of the large intestine. The involved mucous membrane may slough, leaving large areas of denuded surface.

Symptoms.—Increased thirst, colic pains, diarrhea, weakness, paralysis, and death succeed one another rather rapidly in fatal cases. In some instances the life of the affected animal is prolonged for several days, during which time there is rapid emaciation.

Treatment.—Treatment is not satisfactory. In the early stages emetics may be of value, followed by purgatives and mucilaginous drinks.

Atropa Belladonna (*Deadly Nightshade*)

Deadly nightshade poisoning is not of frequent occurrence, although it has been reported in sections of the country where the plant grows.

Lesions.—The lesions are not characteristic. Animals that die within a few hours will show no lesions at all, except retention of the urine or a greatly distended bladder; the blood may be somewhat darker than normal. Those that are affected for one or more days will show a gastro-intestinal inflammation.

Symptoms.—The first symptoms noticed are nausea, followed by vomition, dryness of the mouth, more or less excitement and convulsions, increased pulse and respiration, dilated pupils, and partial blindness. The duration of this period is short and is followed by paralysis. The animals become weak, and stagger, the temperature falls, respiration is slow and weak, gradually becoming shallower, the pulse is rapid and weak, and there is a relaxation of the sphincter muscles. The affected animals soon pass into a state of coma in

which death takes place probably due to asphyxiation and cardiac failure.

Treatment.—Treatment consists in administering the antidotes of atropin; emetics and purgatives; in stimulating the heart, and in resorting to artificial respiration. If there are periods of excitement, or convulsions, the animal should be given sedatives. A valuable aid in correctly diagnosing deadly nightshade poisoning consists in taking a few drops of urine of the dead animal and dropping it into the conjunctival sac of a normal or healthy animal. If the poisoning is due to atropin, or deadly nightshade, a dilatation of the pupil will occur.

The carcasses of animals that have died of deadly nightshade poisoning putrify very slowly.

Garbage

This is the time of conservation, and although the feeding of garbage to swine is not good sanitation, it is a means of utilizing products that would otherwise be wasted.

In the past rather extensive losses from garbage feeding have been reported, but since the advent of anti-hog cholera serum it has been found that many of the cases formerly reported as garbage poisoning were hog cholera, and it is certain that garbage frequently is contaminated with the virus of hog cholera.

Garbage poisoning does not signify any one definite kind of poisoning. From the various reports of investigators it is found that powdered soap, salt, brine, phosphorus, and arsenic are the most common active causes, although occasionally no doubt ptomaines are a factor. Because of the nature of the poisonous substance, cooking the garbage is of little value.

Lesions.—The lesions of garbage poisoning vary and are dependent upon the specific poisonous principle. In practically all cases there is evidence of gastro-enteritis, which may or may not be associated with hepatitis, nephritis, or cystitis. In some instances, for example, those cases dying of strychnin poisoning, no lesions will be found.

Symptoms.—The symptoms like the lesions, are variable and depend upon the nature of the poison. There is usually vomition and diarrhea, associated with listlessness and drooped ears and tail, and as a rule there is marked evidence of colic. The affected animals may die suddenly or they may linger for several days; some of them may recover.

Treatment.—The further feeding of the polluted garbage should be prohibited. Emetics, enemas, and purgatives to effectually remove the offending material are indicated in the beginning. If the specific poison is known, the antidote should be given. In the later stages, treatment of the various symptoms as they arise is good practice.

Cryptogams (Molds, Yeast, Bacteria)

No doubt some forms of garbage poisoning are due to molds, yeast, or bacteria that are capable of producing injurious substances in the alimentary canal or have by their growth and activity produced injurious substances in or upon the foods prior to the time of their ingestion. Gastro-enteritis resulting from the action or products of the above-mentioned vegetable microörganisms is designated cryptogamic poisoning or mycotic gastro-enteritis.

This condition is not so common in swine as in some other domestic animals, notably the horse. Glover, of the Colorado Agricultural Experiment Station, has reported outbreaks of such a disease which were probably due to bacterially decomposed potatoes. Some unauthentic cases have been reported of this condition arising from the consumption of moldy alfalfa. Cases have been observed, but not frequently, of swine that had been fed upon moldy corn dying of mycotic gastro-enteritis and cerebritis.

Lesions.—There is considerable variation in the postmortem findings in swine that have died of mycotic gastro-enteritis. This is not extraordinary, for there is a variety of molds that cause this condition. One usually finds extensive inflammation of the gastro-intestinal mucosa, and in cases that have lingered for some time, ulcerations are very common. There is frequently meningeal engorgement, and in rare cases there may be cerebral softening.

Symptoms.—Two different types of conditions are included in this grouping from the viewpoint of symptomatology. The symptoms in one group consist of inappetence, increased thirst, rise of temperature and weakness. In the other group there will be normal or subnormal temperature, disturbances of locomotion, impairment of vision, anorexia, dysphagia and salivation.

Treatment.—The cause should be identified and removed. Elimination by purgatives is indicated and in severe cases should be assisted by enemas. Stimulants should be used in cases showing pharyngeal paralysis and depression. Intravenous or intramuscular

medication provide the only safe method of administering drugs in cases in which there is pharyngeal paralysis.

Cotton-seed Meal

Fatal results frequently, but not always, attend the feeding for long periods of cotton-seed meal to swine. From experiments thus far conducted it is apparent that cotton-seed as a feed is more applicable to ruminants than to swine. The feeding for short periods has in many instances been beneficial.

Lesions.—On autopsy, excessive quantities of a serous fluid are found in the pleural and peritoneal cavities. The lung is congested, inflamed, and frequently edematous. Congestion in all internal organs may be observed.

Symptoms.—The feces are firm, although diarrhea may be present. Unthriftiness, irregular appetite or inappetence, weakness, unsteady gait, blindness and dyspnea are common symptoms. The animals finally assume the decubital position, and may struggle or may become comatose. Death occurs in from a few hours to several days, sometimes occurring almost instantaneously with premonitory symptoms.

Treatment.—Green feed and exercise have a tendency to counteract the injurious effects of cotton-seed meal. Free access to wood ashes is a valuable but not an absolute preventive of cotton-seed poisoning. Iron compounds have also been used and proved beneficial, while the wood ashes and iron salts are preventive but not curative agents. The treatment of affected animals has not been successful.

PARASITES

The intestine of swine is a common abode for parasites. Parasitic infestation is most prevalent in young animals, but because of the mode of eating and the habits of swine it is rather the exception to find even an old hog entirely free from intestinal parasites. Their injury to the host depends upon the kind and the number of parasites. Intestinal parasites injure swine as follows:

1. Abstraction of nutrition.
2. Obstruction.
   (a) Of the lumen of the intestine.
   (b) Of the lumen of the hepatic duct.
3. Irritation of mucous membrane due to movement.

4. Irritation of mucous membrane due to lip attachment resulting in inflammation, necrosis, and ulceration.

5. Liberation of chemical substances that produce nervous irritation or hematolysis.

The following parasites infest the intestine of swine:

1. Ascaris suum.
2. Esophagostoma dentatum.
3. Trichocephalus crenatus.
4. Trichinella spiralis.
5. Gigantorhynchus hirudinaceus.

Ascaris Suum

Ascarids are found in practically all hogs. They are not blood-suckers in the ordinary sense, but may obtain nutrition direct from lymph as well as by absorption through the external integument. The impregnated female discharges her ova into the intestine and they pass out in the feces. If conditions are favorable, the ova hatch into embryos which become encysted. When such encysted embryos are ingested the digestive juices dissolve their enveloping membrane and the embryos are thus liberated. Some of the liberated embryos pass directly through the walls of the digestive tube, others are entangled in the content of the digestive tube and eliminated with the feces and perish. Some of the embryos that pass through the walls of the digestive tube gain entrance to blood capillaries and are ultimately carried to various parts of the body by means of the circulation. The major portion of these embryos probably perish. Some of the embryos that have passed through the wall of the digestive tube invade the tissues and those that finally reach the air cells of the lung and bronchioles develop into larvae. After the larvae are fully developed they pass out of the lung by way of the air tubes and when they reach the pharynx some of them are swallowed and upon reaching the intestine develop into adults. Thus the embryonal and larval stage produce disturbances of the lung and other organs which will be discussed in the chapters pertaining to those organs.

It has been demonstrated that the embryonal and larval stage of the Ascaris suum may occur in rats and possibly also in other animals.

Lesions.—These parasites are round, and pointed at either end; they are white or pinkish-white in color and vary from six inches to twelve inches in length. Usually they are found in the small

intestine, though they may occur in the large intestine and even in the stomach. They attach themselves to the mucous membrane by means of papillae or membranous teeth, and produce irritation to the mucous membrane as well as provide an avenue of entrance for a variety of bacteria which may produce inflammatory lesions and even necrosis and ulceration. The entire mucous membrane adjacent to the parasites is affected by a catarrhal inflammation.

Fig. 25. Ascaris Suum.

Similar disturbances are observed in the mucous membrane of the hepatic duct when it is infested. The worms may form a mass that completely obstructs the intestine, resulting in an engorgement of the intestine anteriorly to the obstruction. Occasionally the intestine may be perforated and the offending ascarids found protruding into the peritoneal cavity, or they may pass through the intestinal wall and some of the intestinal content, and, escaping into the peritoneal cavity, produce a general peritonitis.

Symptoms.—Infestation with a limited number of ascarids prob-

ably does not produce any noticeable symptoms. The symptoms evidenced will vary and depend upon the manner in which the parasites are damaging their host. If the hepatic duct is obstructed, there will be digestive disturbances, associated with icterus. If the bowel is obstructed, there will be evidence of obstruction colic. Perforation of the bowel will result in peritonitis. The presence of several of these parasites may be suspected when there is catarrhal enteritis, especially when the swine are being properly cared for and given a proper diet of wholesome food. Usually an occasional worm will be passed in the feces. Unless infestation is sufficiently extensive to produce visible symptoms, a positive diagnosis may not be made until the parasites are eliminated or the ova are identified in the feces by microscopic examination. If this condition persists for some time the affected animals become unthrifty and emaciated.

Treatment.—Prevention is far more satisfactory than treatment of infested hogs. The extent of infestation can be materially diminished by keeping the quarters clean. The droppings should be gathered and limed, and the floors in the piggery should be kept clean, and limed or sprayed with some agent that is destructive to the egg and embryo of the ascarids. Common salt destroys the embryo and larvæ of practically all animal parasites, but it must be used with caution in hog premises, for it is also quite destructive to hogs.

Treatment of individual hogs is not difficult if capsules are used. Santonin is probably the most reliable vermifuge for the elimination of ascarids. It is advisable to combine santonin with calomel and a purgative such as aloin. The dosage for a 50 to 100-pound shote should be santonin and calomel 2½ grains each and aloin 5 grains. It is always advisable to withhold feed and water for at least twelve hours, the period depending upon weather conditions, before the capsule is administered and then provide an ample supply of water for the swine so they may drink freely after the capsules have been administered. Care must be exercised that the capsule is not deposited in the pharyngeal cul-de-sac and that no other injury is done by the balling gun.

Esophagostoma Dentatum

Esophagostomiasis is a disease caused by the invasion of the Esophagostoma dentatum into the submucosa of the large intestine of swine, a condition not very common in America. This parasite

is parasitic in its larval stage. Its life cycle has not been entirely worked out, but the ova are discharged from the animal body in the feces and hatch, if climatic conditions are favorable, into embryos. Later changes are unknown, but the larvae are ingested with food or drink and bore into the submucosa of the large intestine, where they remain from six to seven months and produce small nodules in which they undergo various metamorphoses, finally becoming sexually mature. They then leave the submucosa nodules and migrate into the lumen of the intestine, where copulation occurs and the female later ovulates in the same location.

Lesions.—The principal lesion is the submucous nodule that occurs in the large intestine. There may be only a few nodules, or there may be many. These nodules are inflammatory, caused by the presence of the larvae. They are definitely circumscribed with a fibrous capsule; the content of which is inflammatory exudate that later becomes purulent, then caseous, and may ultimately calcify. The nodules first cause a slight, hard, spherical elevation of the mucous membrane about the size of millet seed, but they may later become as large as a pea. In the later stages they assume a greenish-gray cast due to the accumulation in them of pus. The nodules frequently produce erosions and ulceration of the intestinal mucosa, and they may persist and appear as caseated incapsulated masses. The adult parasites may be found free in the large intestine. They are about three-fourths of an inch in length.

Symptoms.—The extent of invasion sufficient to produce visible symptoms has not been determined, but it is not uncommon to find a few nodules in the intestine of swine that were slaughtered in packing houses and were known to have been previously healthy. The usual symptoms consist of a profuse and persistent diarrhea, emaciation, weakness, and death in the intensely infested animals. The disease is essentially chronic. The course is from two to three months.

Treatment.—Because of the location of the offending larvae, medication is of no avail. A small percentage of the animals may be saved by dieting and treating the symptoms as they arise. Prevention of further spread of the disease should be the chief consideration.

Trichocephalus Crenatus

This parasite is not of common occurrence in America. The worms are in shape similar to the old-fashioned blacksnake whip, the head

end very thin and hair-like, the posterior extremity being thicker and thread-like. They are usually coiled, and are from one to one and one-quarter inches in length. Their life cycle is similar to that of the Esophagostoma. Infestation is accomplished through the food or drink.

Lesions.—The Trichocephali are blood suckers, but they appear to do very little damage unless they occur in large numbers. When they produce anemia there is also more or less intestinal catarrh. The parasites are found firmly attached to the mucous membrane of the large intestine.

Symptoms.—The principal symptoms are diarrhea, emaciation, and weakness.

Treatment.—Practically the same as described for the Ascaris suum.

Trichinella Spiralis

Trichinella spiralis passes only the adult stage of its life cycle in the intestine. The larvae are important muscle parasites. Further discussion will be found under "Muscular Parasites."

Gigantorhynchus Hirudinaceus

This, the thorn-headed intestinal worm of swine, is quite prevalent in practically all sections of this country. It is a thick, cylindrical, white worm with an attenuated tail portion, transverse markings, and a head provided with a globular proboscis having several rows of hooks. The ova pass to the ground with the feces and are ingested by the larva of the May beetle, in which it passes a portion of its life cycle, the embryo and larval stages. Hogs consume the May-beetle larva and the inclosed gigantorhynchus larva is liberated and passes into and attaches to the intestine of the hog. It is thought that the ova may develop elsewhere as well as in the May-beetle larva.

Lesions.—Upon opening the abdomen of a swine infested with the Gigantorhynchus, shiny nodules of a grayish color are readily visible on the serous coat of the intestine. The thorn of the worm is found to have penetrated the mucosa, and thus permits of infection which results in the production of an inflammatory zone. The parasites may become detached, the lesions produced having healed by the formation of cicatricial tissue, which is usually easily recognized Not infrequently the head of the parasite bores through the entire intesinal wall and occasions general peritonitis.

Symptoms.—The usual symptoms consist of digestive disturbance the magnitude of which will depend upon the extent of infestation. The infested animal usually gives evidence of pain, as the parasite lacerates the tissues during its attachment. There may also be muscular twitching.

Treatment.—These parasites are difficult to dislodge. Long-

Fig. 26. Gigantorhynchus Hirudinaceous.

continued medication with creosote alterated with copper sulphate has proved effectual in many cases.

TUMORS

Intestinal tumors are not prevalent and are of little economic importance.

Connective tissue tumors may develop and mechanically interfere with intestinal movement or they may obstruct the lumen of the bowel. Fibromas and myxomas have been observed, usually having their origin in the subserosa or within the serous coat of the intes-

tine. These tumors are definitely encapsulated. It is usually not possible to make a diagnosis except by autopsy.

Of the malignant tumors, carcinoma, epithelioma, adenoma, and different varieties of sarcoma have been identified. The embryonic epithelial tumors may be primary or secondary. Primary epithelial tumors usually have their origin in or from the mucous membrane. Secondary epithelial tumors may involve any portion of the intestinal wall and are more frequently encapsulated than the primary tumors. The primary epithelial tumors, especially epitheliomas, are very prone to produce necrosis of the surface mucous membrane and thus cause ulceration.

General sarcomatosis of the entire abdominal viscera is occasionally observed. Sarcomas in swine are apparently not so malignant as in other domesticated animals, and are more frequently encapsulated. The appearance of the various malignant tumors in swine is the same or very similar to that of the same type of tumor in other animals.

Intestinal malignant tumors, generally speaking, are evidenced by unthriftiness, indigestion, emaciation, marasmus and finally by death.

Diarrhea (Dysentery)

Diarrhea is a common symptom of a variety of diseases and conditions. In some instances there is an apparent diarrhea without any associated disease or condition. Diarrhea in young pigs—"pigs scour" is discussed in detail on page

Etiology.—The usual cause of diarrhea is improper diet; moldy or fermented feed and immature feed, such as soft corn, are common causes of diarrhea. Sudden changes from dry to green feed or to garbage is frequently responsible for the production of diarrhea in swine. Diarrhea is also an outstanding symptom of diseases of the digestive tract, particularly necrotic enteritis.

Symptoms.—Diarrhea is manifested by frequent evacuations of the bowel, the discharge being of a semi-fluid or fluid consistency. The affected animals usually drink excessively, although their appetite may be normal or only slightly altered. If the condition continues the affected animals become thin and gaunt.

Treatment.—The cause should be determined and removed. A diet of relatively dry feed should be provided. The supply of water should be so regulated that the affected animals get less than the nor-

mal amount. Oleaginous purgatives, such as castor oil frequently repeated in relatively small doses, should be administered until the content of the intestine has been removed. Intestinal antiseptics should be administered in the feed. If the diarrhea is not corrected by the use of oleaginous purgatives and intestinal antiseptics, bismuth subnitrate in dram doses should be used.

Constipation

Constipation is a condition in which the fecal matter becomes relatively dry and hard and there is infrequent and incomplete elimination from the bowel. It is a symptom of a variety of diseases and may occur as a primary condition.

Etiology.—Constipation as a primary condition is usually produced by improper feeding or insufficient exercise. Feeding upon dry bulky feeds, especially if water is supplied in limited quantities, usually results in constipation. When swine are closely confined, as is frequently the case with fattening hogs, brood sows or boars or when there is no inducement to take exercise, constipation is likely to occur. Intestinal parasitism may cause constipation. In the various febrile diseases constipation is a common symptom.

Symptoms.—Frequently attempts to defecate with the passage of small quantities of hard feces is the prominent symptom of constipation. There may be a fullness of the abdomen, and in some cases accumulation of gas in the intestine may be observed. If the constipation continues for several days the affected animal will have a diminished appetite and may show evidence of colicky pains. Affected animals are dull and have a tendency to assume the decubital position. As a result of frequent straining in attempting to defecate there may be eversion of the rectum. In extreme cases the affected animals may vomit.

Treatment.—If the diet is found to have been the principal causative factor it should be corrected. Arrangements should be made for proper exercise of the affected animals. Slop feed in limited quantity and an abundance of water should be provided. In severe cases enemas will be found of value. Care must be exercised not to overdilate the intestine and it is advisable to use a warm solution to stimulate intestinal movement.

Laxatives or purgatives may be administered, providing the posterior bowel is not impacted with dry fecal matter. Castor oil or

linseed oil may be administered by means of a dose syringe, giving relatively large doses.

Prolapse of the Anus and Rectum

Prolapsus ani is a condition in which the mucous membrane of the rectum protrudes through the anus. The protrusion of the mucous membrane occurs normally during defecation, particularly in the horse. Prolapsus recti is a protrusion of the entire intestinal structure of the rectum through the anus.

Prolapsus ani is relatively common in swine and occasional cases of prolapsus recti are observed. Several pigs weighing 50 to 70 pounds each, were observed affected with prolapsus ani. These pigs were on pasture and were being fed middlings in slop.

Etiology.—Protrusion of the rectal mucosa or the entire rectal structure is caused by increased abdominal pressure. These cases are frequently observed in swine in which there has been severe diarrhea. Constipation or intestinal obstruction may cause prolapsus ani or recti. Proctitis induced by hot or irritating enemas may cause this disturbance. Restraint of exceptionally resistant animals may produce temporary or permanent prolapsus.

Symptoms.—In prolapsus recti a hemispherical mass of mucous membrane, red and sensitive, projects from the anus. A larger and more dense swelling is present than in prolapsus ani and it becomes edematous. In some cases of prolapsus recti the intestinal structure may protrude four to eight inches from the anus. In cases of prolapsus that have persisted for several days the mucous membrane becomes dry and may undergo necrosis and slough, thus affecting a spontaneous recovery. In cases of prolapsus recti in which there is a noticeable protrusion, the protruded portion usually becomes injured from lying down or is lacerated by other pigs.

Treatment.—Prolapsus ani of recent development may be corrected by first cleansing the protruding mucous membrane and then by steady pressure it can usually be forced into its normal position. Straining or tenesmus may be prevented by the use of rectal injections of chloral hydrate or oleaginous substances. The causative factor of diarrhea or constipation should be relieved, the medicament employed depending upon indications.

Prolapsus recti of recent origin may be corrected by the same procedure as indicated for overcoming prolapsus ani. In cases of long

standing surgical interference is necessary. The protruding portions should be cleaned and two needles with double thread passed through the entire mass. The protruding portion can thus be ligated in four places by combining one thread from each of the sutures. After the ligation has been completed the protruding portion may be removed by a scalpel. In such operative cases it is necessary to give an enema or produce a liquid condition of the feces by means of purgatives.

Liver

The liver is a very important organ physiologically, and it is of such magnitude that derangement of its function and disease usually result in marked metabolic disturbance of the affected animal. The diseases of the liver of swine have not received clinical consideration, and little is known of the pathologic conditions in the liver of swine excepting the observations recorded by men employed in the inspection of meat.

MALFORMATIONS

Malformations of the liver are not of much importance. There may be too few or too many lobes. The lobes may be entirely separated. Rarely, the gall-bladder is wanting.

FOREIGN BODIES

Several hog livers have been observed that contained quantities of sand or cinders, varying in volume from an ounce to a quart. These cases have been observed in swine killed at abattoirs, and without exception the affected animals were in prime condition.

The avenue of entrance of the sand and cinders is no doubt through the hepatic duct. The manner in which the foreign substances gain entrance and "back-tell" in the ducts to the gall bladder and from there into the collecting cystic ducts in the liver has not been determined. The hepatic duct orifice in the summit of the duodenal papilla probably becomes enlarged through injury, or atrophy of the surrounding mucosa, and this, in conjunction with a full stomach and intestine, would facilitate the passage of the foreign substance through the orifice and into the hepatic duct. The irritation of the foreign substance may cause relaxation of the sphincter muscles and also establish reverse peristalsis. It may be possible that the cause may be due to irregular action of the intestinal musculature. In

all of the cases observed the hepatic duct was found gorged with the foreign material, the duct in some instances being more than one inch in diameter; the cystic duct and gall bladder were found to contain varying quantities of the same material. In one case the gall bladder was so engorged with sand that it had dilated until it was fully as large as a quart measure. The foreign substance, either cinders or sand, may also be found in the ducts that convey the bile to the gall bladder. In some instances the biliary capillaries contained considerable quantities of sand. The accumulations obstructing the outflow of bile result in icterus of varying intensity. There is also a catarrhal inflammation of the adjacent intestinal mucosa and the mucous membrane of the bile tubules, gall-bladder, and hepatic duct.

RUPTURE

Rupture or laceration of the liver does occur, although it is not so common in swine as in most other animals because the abdominal wall of swine is comparatively thick, due to the deposition of subcutaneous fat.

Etiology.—The usual cause of hepatic rupture is mechanical interference in the form of a sudden blow, such as the kick of a mule or the penetration of the liver with some sharp object which may lacerate the hepatic tissue.

Lesions.—If the hepatic lesion has caused sudden death the peritoneal cavity will contain a large quantity of blood which may or may not be coagulated, depending upon the length of time after death that the autopsy is conducted. If the injury is an old lesion, cicatricial tissue will have sealed the wound and perhaps, by contraction, distorted the liver.

Symptoms.—The symptoms evidenced will be shock, weakness, and blanched visible mucous membranes due to loss of blood from the blood vascular system. Should the animal survive the immediate effect of the injury and the loss of blood, there may be symptoms only of impaired hepatic function, or there may be no visible symptoms.

Treatment.—Because of the nature of hepatic rupture, treatment is of no avail. In cases that will probably have a fatal termination the animal may be bled to death and the carcass thus saved for meat.

ICTERUS

Icterus or jaundice is a condition resulting from the deposition of bile or bile pigments in the various tissues. This condition is relatively common and is significant as a diagnostic factor.

Etiology.—Icterus may be the result of obstructed outflow of bile. It may result from excessive destruction of red blood cells, of failure of elimination of bile from the blood. Obstructed outflow of bile may be due to calculi, parasites, or foreign bodies in the bile ducts, closure of the duct by cicatrices, muscular spasms, tumors, abscess, aneurysms, fecal matter, parasitic cysts, or inflammatory disturbances of the mucous membrane of the duodenum or the various bile ducts. Excessive production of bile in the blood occurs as a result of hemolysis due to chemic substances in such diseases as hog cholera, swine plague, septicemia, pyemia, generalized anthrax, phosphorous and phenol poisoning, and also as a result of the injection of the venom of some poisonous snakes. Failure of elimination of bile occurs not only when the outlets are obstructed but also when considerable numbers of liver cells have been destroyed or their functional capacity diminished.

Lesions.—Bile staining is most evident in the conjunctiva and ocular sclera of the living animal, where it produces a lemon-yellow or greenish-yellow discoloration. If the reabsorption of bile is very extensive it may appear in the urine. In carcasses biliary pigmentation is most evident in the adipose tissues, especially the subcutaneous fat, although it is usually well marked in the subserous fat and may be detected in the lymph nodes, spleen, kidney, and muscular tissues. On microscopic examination the bile pigments may be found in the cells or between the cells as greenish-yellow amorphous granules.

Symptoms.—The effects of icterus are variable. The tissues are discolored; there may be pruritus, cardiac depression, vomition, coma, and death. The symptoms above outlined are probably not due to the presence of the bile pigments in the tissue, but to other substances that have not been eliminated.

Treatment.—Removal of the cause is usually all that is required for complete recovery from icterus. If the cause cannot be identified, then the symptoms should be treated as they arise, purgation and especially calomel in 5 to 10 grain doses are of value in these cases.

CLOUDY SWELLING

Cloudy swelling, or parenchymatous degeneration, is a condition in which a portion of the cell protoplasm is coagulated. This condition is very common. It is frequently the forerunner of fatty changes.

Etiology.—Coagulation of portions of the cell protoplasm may be caused by high temperature, as is evidenced in fever or overheat, or it may be caused by bacterial products and other chemical poisons.

Lesions.—The affected liver is enlarged, paler in color and more friable than normal.

Symptoms.—The symptoms are usually associated with those of other disturbances and are therefore not specific. There is evidence of disturbed hepatic function, and often a slight icterus and tendency to constipation.

Treatment.—To ascertain and then remove the cause is of prime importance. This condition is corrected only through the efforts of the body, therefore, provide the proper diet and maintain sanitary conditions.

FATTY CHANGES

Fatty changes in the liver are of common occurrence in swine. The usual change is first an accumulation of fat droplets between the cells and later a fatty degeneration of the cells.

Etiology.—Fatty changes in the liver may be due to excessive nutrition, diminished exercise, hereditary influences, long-continued fever, bacterial products, and such chemical poisons as phosphorus. Fatty degeneration of hepatic tissue is sometimes observed in conditions associated with malnutrition.

Lesions.—The liver is enlarged, gray or grayish-red in color and lighter than normal in weight; when incised, droplets of fat or oil may be observed on the knife. Fatty changes are usually uniformly distributed in the entire liver; however, in exceptional cases, one lobe only may be involved.

Symptoms.—The evidences of fatty changes in the liver are not characteristic. The condition may be suspected in obese animals or those known to be affected with chronic arsenic, antimony, or phosphorous poisoning.

Treatment.—There is no treatment that is of any special value other than to correct the diet.

AMYLOID CHANGES

Amyloid changes in the liver are rather uncommon in swine. The cause is unknown. The affected liver is larger, paler, and firmer than normal. The amyloid areas are homogeneous and translucent in appearance, the amylaceous substances usually occurring in definite foci, though they may be quite diffuse. This condition may be associated with other diseases which tend to mask any specific symptoms. One case of amyloid change has been observed in a hog that clinically showed no manifestation of disease and was in prime condition at the time of slaughter. The amylaceous substance is insoluble, and the condition is therefore probably incurable.

GLYCOGENIC INFILTRATION

Glycogenic infiltration is a condition in which excessive quantities of glycogen accumulate in the liver. This condition is observed occasionally in the liver of slaughtered swine.

Etiology.—Disturbed carbohydrate metabolism is inseparably associated with glycogenic infiltration, although the specific relation of disturbed carbohydrate metabolism and glycogenic infiltration is not known. Inflammatory disturbances and tumor formation appear to have some relationship with glycogenic infiltration.

Lesions.—A glycogenic infiltrated liver is pale, larger than normal, and of a putty consistency.

Symptoms.—No definite symptoms are attributed to the excessive accumulation of glycogen in the liver. The condition may be suspected when the animals are sluggish and do not exercise, as it has been demonstrated that during muscular activity glycogen is used in considerable quantities and is drawn from the storehouse, which is the liver, as it is required.

Treatment.—Regulation of diet and exercise are far more valuable than medicinal treatment.

GALL-STONES (CHOLELITHIASIS)

Gall-stones are accumulations of organic or inorganic substances in the various bile tubes or gall bladder. They are relatively common in swine.

Etiology.—The presence of a substance that will act as a nucleus is the first step in the formation of a calculus. Precipitation of some of the bile ingredients is the second step in calculus formation, and

the accumulation of the precipitate upon the nucleus completes the process. Bits of mucus or any particle of foreign matter may serve as a nucleus. Precipitation may be caused by supersaturation of the bile with inorganic salts, or it may be a sequel of fermentation of bile. In addition, bacteria and other factors may be causative agents of calculus formation.

Infection of the gall-bladder provides the necessary conditions for the formation of gall-stones and is probably the most important cause of their formation.

Lesions.—Cholelithiasis, or gall-stones, is found most frequently in the gall-bladder. It may occur, however, in the hepatic duct or in any of the collecting bile tubes regardless of their size. The presence of gall-tones usually causes obstruction and distention of the gall bladder or of the bile tubes in which they occur. If the obstruction has existed for some time, icterus will usually be more or less pronounced.

Upon opening the gall-bladder or bile ducts containing the calculi, thick grumose bile escapes and the concrements or calculi are observed. Gall-stones may occur singly, but they are usually multiple. They are usually of a brownish-chocolate color and vary in size from mere specks to masses an inch or more in diameter. They may be round or any other shape, and when many are present they are usually faceted when they come into contact with each other. The gall-stones may be composed of organic material entirely and be quite soft or they may be encrusted with mineral matter and be quite hard. Upon sectioning them they are usually found to have been made up in layers, and it is not difficult to distinguish the nucleus. There is an inflammation of the mucous membrane of the gall-bladder or affected bile tubes.

Symptoms.—Very few if any cases of cholelithiasis have been recognized clinically. If the gall-stones obstruct the outflow of bile sufficiently there will be general icterus. There are probably some digestive disturbances also.

Treatment.—The administration of purgatives, especially calomel, is indicated and should be administered regularly in small doses. The treatment will probably not produce permanent relief, but the icteric condition may be overcome by the action of the calomel and the meat made fit for human consumption and the animal can be slaughtered.

HYPEREMIA

Hyperemia of the liver may be physiologic or pathologic. Physiologic hepatic hyperemia occurs after eating and is of no significance economically or pathologically. Pathologic hepatic hyperemia may be either venous (passive) or arterial (active).

Passive hepatic hyperemia is caused by obstructed outflow of blood. Cardiac defects of the valves of the right side of the heart are a potent cause. Obstruction of the posterior vena cava or the hepatic vein by new growths, abscesses, and cicatricial tissue will also produce venous engorgement of the liver.

Lesions.—A careful examination will disclose the lesion producing the engorgement as well as the engorged condition of the liver. The liver will be full of blood and of a slightly darker color than normal. If the condition becomes chronic there will be fibrous proliferation.

Symptoms.—The signs of venous hepatic hyperemia vary according to the intensity of the condition and its duration. The animals become dull, and there is only a sluggish action of the bowels. If the condition progresses until there is fibrous proliferation, disturbances of nutrition become evident.

Arterial hepatic hyperemia may be the result of involvement of the hepatic artery or of the portal vein. This is a condition characterized by an increased inflow of blood into the liver. Hyperemia of the hepatic artery is not common, and when it does occur it is usually chronic. This condition is usually the result of partial occlusion of the gastric or splenic branches of the celiac axis, although it may be caused by some irritation in the terminal vessels in the hepatic interstitial tissue. No definite symptoms are evidenced, and the value of treatment is doubtful.

Portal hepatic hyperemia is usually caused by tainted foods or by infection. The liver may be increased fifty per cent in volume, and becomes gorged with blood. The symptoms are obscure. Some relief may be obtained by the free use of laxatives.

Treatment.—The removal of the cause, if that be possible, is about all that can be accomplished.

HEPATITIS

Inflammation of the liver, or hepatitis, is rather common in swine. The condition may assume either an acute or chronic form.

Hepatitis as a rule is secondary to other disturbances, although it may occasionally be primary. The inflammatory process may affect the liver cells and is then designated *parenchymatous hepatitis*, or it may affect the supporting framework, when it is designated *interstitial hepatitis*. With but few exceptions hepatitis of swine has not been made a subject of special investigation. An enzootic hepatitis of young pigs occurred in Russia and was investigated by Semmer. This disease has also occurred in eastern Prussia, where it has been very fatal. The cause of this condition is probably a coccus which is thought to gain entrance into the umbilicus at the time of farrowing. The affected liver is enlarged, nodular and variegated in color.

Acute Parenchymatous Hepatitis

Acute parenchymatous hepatitis is a destructive inflammation involving the liver cells.

Etiology.—Chemic poisons derived from the bowel and carried to the liver by way of the portal vein are frequent causes of this condition. Bacterial infection entering the liver by way of the portal vein, hepatic artery, hepatic vein, umbilical vein, or hepatic duct is a common cause of hepatitis. The Distoma or liver flukes, the larval form of Stephanurus dentatum, and other parasites produce hepatitis.

Lesions.—The liver becomes enlarged and loses its sharp outlines; it is darker in color, gorged with blood, and is more friable than the normal liver. There may be small hemorrhagic areas.

Symptoms.—Icterus is usually the first and frequently the only evidence of the disease. The affected swine may show symptoms of pain when defecating or when moving about.

Treatment.—Laxatives may produce some relief. The proper diet should be given and the animals made comfortable.

Suppurative Hepatitis

Suppurative hepatitis as a primary condition is not very common in swine.

Etiology.—This condition is, as a rule, the result of bacterial infection, although parasites of various kinds may produce it. The infection in the liver is usually secondary and metastatic. Pyogenic staphylococci and streptococci are the most common infecting agents.

although the colon bacilli and its various derivatives have been identified in the pus from liver abscesses.

Lesions.—The liver contains suppurative centers of varying dimensions. The foci may occur throughout the entire liver and be microscopic in size, causing a uniform enlargement of the liver, or the suppurative centers may be as large as walnuts and appear as small abscesses. The liver will be engorged with blood, more friable than normal, and it may be variegated in color, due to alternating small hemorrhagic areas and suppurative foci.

Larger suppurative centers are gray in color and may or may not be circumscribed by a capsule of fibrous tissue. The content may be semifluid pus or it may be caseous or even calcified.

Symptoms.—The evidence of suppurative hepatitis consists of general depression. The animal does not move of its own volition. There is pain on palpation of the abdomen (if abdominal walls are not too thick), and icterus. Less extensive suppuration of the liver may not produce any distinct symptoms.

Treatment.—The animal should be made as comfortable as possible and the evacuation of the bowel content facilitated by the use of laxatives.

A type of hepatitis associated with a perilobular eosinophylic infiltration has been observed. These cases are of rather common occurrence in meat inspection but apparently are of little significance clinically, at least we are unable to find any reports of cases from practitioners. The cause of eosinophylic infiltration into the liver has not been determined but it is probably associated with parasitic invasion, perhaps more particularly with the migration of the larval form of parasites such as the ascarids.

Affected livers are enlarged and contain small grayish white centers. On microscopic examination the white centers are found to be masses of eosinophylic leucocytes. Local invasions of eosinophiles have been observed in other tissues and appear to depend upon the motility of the eosinophiles, although technicians claim that these cells are not motile. Chemic substances derived from parasites may produce an activity of the eosinophiles or may stimulate these cells to multiply in the field of action. The phenomenon is certainly the response of some abnormal stimulus and in a general way is parallel to the neutrophylic, polymorphic, leucocytic migration toward a suppurating center.

Acute Interstitial Hepatitis

Acute interstitial hepatitis is not a common condition but it does occur in swine and therefore should receive some consideration.

Etiology.—The cause of acute interstitial hepatitis probably always enters the liver by way of the hepatic artery, and is most frequently due to bacterial infection or animal parasitic invasion. The various suppurative bacteria, Bacillus coli communis or some of its derivatives and Bacillus necrophorus, may be the causative agent. Protozoan parasites and the larvae of some vermes are responsible for some cases of acute interstitial hepatitis.

Lesions.—The liver is enlarged and appears to be affected with chronic interstitial hepatitis because the interlobular tissue is infiltrated with leukocytes. The liver tissue is soft and friable. Microscopic study of these livers has revealed the fact that in nearly every instance the infiltration leukocytes are practically all eosinophiles.

Symptoms.—Few if any investigations of these cases have been made clinically or at least such have not been reported. The marked interlobular infiltration tends to obstruct the biliary capillaries, causing reabsorption of bile with accompanying icterus.

Treatment.—The nature of this condition permits of little if any relief by the use of drugs. Providing the proper diet and surroundings are provided, treating the symptoms as they arise is apparently all that can be advised for the relief of this condition.

Chronic Interstitial Hepatitis (Cirrhosis-Sclerosis)

Chronic interstitial hepatitis, cirrhosis or sclerosis of the liver, consists of a proliferation of fibrous tissue which damages and ultimately displaces some of the functional liver tissue. The condition is rather common, especially in swine fed upon fermented products, such as distillery waste, or garbage.

Etiology.—This condition is due to injurious chemical agents derived either from the food or from bacterial action, that is, those substances that are capable of producing a mild degree of irritation. Animal parasites, either by direct mechanical irritation or irritation by eliminated chemicals, also produce chronic interstitial hepatitis. The condition, too, may be secondary to other disease processes.

Lesions.—Chronic interstitial hepatitis is essentially a proliferation of fibrous tissue. The fibrous tissue may be produced within the liver lobule, causing an enlargement of the lobules and also of

the liver. This type is designated hypertrophic sclerosis of the liver. Such a liver is enlarged, dense, increased in weight, lighter in color, and when cut gives the impression of cutting fibrous tissue. In other instances the proliferation of fibrous tissue occurs in the interlobular tissue only. This newly formed fibrous tissue later contracts, thus diminishing the size of the affected lobules, and therefore the liver as a whole. This condition is termed atrophic sclerosis. Such a

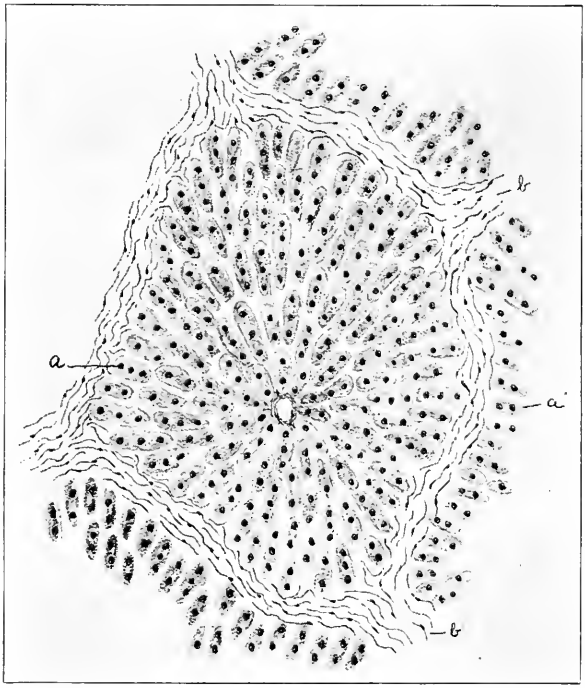


Fig. 27. CHRONIC HEPATITIS. a Liver cell; b fibrous proliferation.

liver usually has an irregular outline (hobnail-liver) and is smaller, denser, and lighter in color than a normal liver. It is possible that hypertrophic sclerosis, or the formation of new fibrous tissue throughout the entire liver lobule, follows when the irritant is introduced through the portal vein, and atrophic sclerosis occurs when the irritant is introduced through the hepatic artery.

Symptoms.—Hepatic sclerosis has an insidious onset. Probably the first evidence of the disease is digestive derangement, which later

may be accompanied by icterus. The animals become unthrifty and finally weak and emaciated.

Treatment.—Remove the cause and prevent further progress of the disease. A strict diet and the maintaining of a laxative condition of the bowel may permit the affected animals to be gotten into condition for slaughter.

TUMORS

Hepatic tumors are frequently observed by veterinary inspectors in abattoirs, but these tumors are rarely of sufficient magnitude to have produced visible symptoms in the animal prior to slaughter.

The various kinds of tumors that have been observed in the liver of swine are true to the type for the same tumors in other animals. The malignant tumors of the liver frequently are found to be secondary. Of the types of liver tumors the following have been identified, lipoma, myxoma, angioma, sarcoma, adenoma, epithelioma, and carcinoma.

No definite symptoms of hepatic tumors can be described; often there is no outward evidence. There may be digestive disorders, emaciation, and evidence of malnutrition.

The treatment of hepatic tumors in swine is not practicable.

PARASITES

Parasitic invasion of the liver is very common in swine. The result of hepatic parasitism has not attracted the attention of the clinician, but it has caused considerable concern with the inspectors of meat and food products. In the middle section of the United States the livers of the majority of swine evidence parasitism or lesions indicating previous parasitic invasion and activity. Parasitic conditions of the liver of swine are of considerable economic importance because of the condemnation, and therefore the loss, of this organ as a food product.

Coccidiosis

Liver abscesses containing Coccidia have been observed. The conditions are not very common. Johne observed in swine abscesses as large as an apple that contained a Coccidium to which he attributed the cause.

Stephanurosis

Liver lesions in swine due to invasion by the Stephanurus dentatum are rather common. This parasite may gain entrance into the body either through the skin or through the digestive tube. The lesions succeeding skin entry are usually found in and around the kidney and the lesions succeeding digestive tube entry are apparently confined to the liver. The life cycle of this parasite has not been positively proved, but it is probable that the adult produces ova while in lesions established in the animal body. The lesions in and around the kidney provide an avenue of elimination of the ova by way of the urinary passages, but the lesions in the liver are usually of such a nature that there is little chance for the ova to escape. The ova hatch outside of the animal body into embryos which after molting contaminate food and are ingested or infest the skin and permeate the tissue and establish lesions in which the young parasites develop to maturity and ovulate.

The mode of entrance of these parasites into the liver may be by way of the hepatic duct, through the portal vein, or by direct migration from the peritoneal cavity through the liver capsule. They establish inflammation accompanied by the formation of pus and later necrosis of the liver tissue. The entire lesion is surrounded by a rather dense white fibrous connective-tissue capsule. From one to three of the parasites are found in the necrotic purulent material. The content of the lesion later becomes caseous and may ultimately calcify.

No symptoms have been observed in the liver that could be attributed to the direct action of the Stephanurus.

Remedial treatment is not available, but preventive measures should be taken to avoid future disturbances. The exact life cycle of the parasite is not known, but general sanitary regulations are always in order and will no doubt be of value in preventing or at least diminishing the extent of future infestations.

Ascaridiasis

An occasional ascarid migrates into the liver by way of the hepatic duct. These parasites in this location mechanically obstruct the outflow of bile and also produce sufficient local irritation to establish a catarrhal inflammation of the hepatic duct, the gall bladder, or the bile duct.

Icterus, associated with digestive derangement, will probably be the only evidence of the presence of this parasite in any portion of the liver or its excretory duct.

The location of the parasite prohibits the successful use of therapeutic agents. The possibility of invasion into any of the hepatic structures may be diminished by frequent medication of the swine with agents previously mentioned that will eliminate these parasites from the bowel. Frequent cleaning, and removal of the excrement from the pens, yards, or barns, will tend to diminish infestation.

Distomatosis

This is a condition resulting from the invasion of the liver by the Distoma hepaticum, Distoma Americanum, or Distoma lanceolatum. All are commonly called flukes. Distomatosis occurs most frequently in animals kept upon low, marshy, or swampy lands. Swine raised in the southern part of the United States are commonly infested. The exact life cycle of these parasites has been carefully worked out and may be obtained by reference to works on parasites; suffice here to say that the ova are eliminated from the liver in the bile and pass to the outside in the fecal matter. After several changes the embryos are found upon vegetation which is consumed by their hosts. They find their way up the hepatic duct and on into the bile tubes within the liver.

Fig. 28. Distoma Hepaticum.
a. Intestines.
b. oral sucker.
c. Ventral sucker.
d. uterus.

Lesions.—The lesions established by the different types of Distoma are slightly different. The Distoma hepaticum remains for six months in the bile tubes in the liver where it produces obstruction of bile and inflammation of the bile tubes. The accumulated bile causes distention of the bile tube, which is usually very evident, particularly upon the posterior surface of the liver. The dilated bile tube is found to be thickened and contains thickened flocculent bile and flukes in some stage of development, depending upon the length of time after invasion that the autopsy is conducted.

The Distoma Americanum either remains in the bile tubes or passes out into the substance of the liver, where it produces a cyst. The cysts, which attain the size of a hen's egg, are evidenced by grayish-black elevations upon the surface

of the liver. The cysts contain a chocolate-colored fluid and one or more distomes.

The Distoma lanceolatum produces lesions similar to those produced by the Distoma Americanum. The latter parasite is easily distinguished from the former by its large size and its distinctive shape.

A liver in which the Distoma have developed and disappeared contains cicatrices or areas of necrotic calcareous material, evidences of the parasitic invasion.

Symptoms.—It is difficult to diagnose hepatic distomiasis by the clinical symptoms. The history of the case, particularly the source of the animal affected, should be given proper consideration. The symptoms vary according to the intensity of infestation, and do not appear for from one to two months after infestation. There is more or less icterus, digestive derangement, unthriftiness, and emaciation. The disease may terminate fatally and it may be quite widespread, affecting a large percentage of swine in the Southern States, particularly during wet seasons.

Treatment.—Treatment is of no avail. Invasion may be diminished or entirely prevented by keeping swine out of pens, yards, and pastures where previous infestation has occurred and by properly disposing of the excrement of swine that are infested.

Echinococcosis

The invasion of the liver of swine with the larvæ of the Tænia echinococcus is quite common. In the Old World from one per cent to seventy per cent of the swine are reported to be so infested.

The mode of the entrance into the liver is by way of the portal system, the embryo passing through the intestine into capillaries that empty into radicles of the portal vein. Infestation is derived from food or drink contaminated with the feces of dogs that harbor the Tænia echinococcus.

Lesions.—The liver is enlarged; the degree depending upon the number of parasitic cysts it contains. Gerard observed an infested swine liver that weighted 110 pounds. The surface of the liver may be very irregular due to the presence of the cysts near the capsule or just beneath the capsule. The cysts which vary in size from a pear to a small hen's egg, are the primary lesions and may be polymorphous or multilocular. The polymorphous cysts are surrounded by a fibrous capsule inside of which the true cystic mem-

brane is found and upon which daughter and granddaughter cysts and the head of the future tapeworm may be seen. The cyst contains a pale straw-colored, limpid serum. The multilocular cyst is a mass of single cysts developing on the outside of the true cystic membrane instead of developing on the inside, as in the polymorphous cyst. The cysts necessarily displace and by pressure destroy liver tissue. Old cysts contain a cheesy or caseous substance; in some instances a purulent substance.

Symptoms.—Chemical evidence of the presence of hepatic echinococcus cysts are usually wanting. A few cases of ascites associated with hepatic echinococcosis have been recorded. There may be icterus and some digestive disturbance.

Treatment.—Because of the location and nature of the lesion, treatment for echinococcosis is ineffectual. The condition is readily prevented by treating with teniafuges all valuable dogs that are associated in any way with the swine and by destroying all worthless curs and properly disposing of their carcasses.

Cysticercosis

Hepatic cysticercosis of swine is not very common. It is found principally in young pigs, where it is the result of invasion of the liver with embryos of the Tænia marginata of the dog. These embryos are obtained in food that has been contaminated with dog feces. They gain entrance to the liver by way of the portal vein. Some of the embryos pass out of the liver in the hepatic vein; others bore through the organ and its capsule into the peritoneal cavity.

Lesions.—In extensive invasion the liver is enlarged. There may be evidence of perihepatitis. A small elevation may occur upon the surface and in each elevation a small opening may be observed. The liver is of a variegated color, due to alternating areas of hemorrhage and degeneration.

Symptoms.—Unthriftiness, weakness, anorexia, and increased thirst may be observed in hepatic cysticercosis. The affected animals may become rapidly emaciated; there may be evidence of peritonitis—and in exceptional cases the animals may die suddenly, but as a rule they linger for several weeks.

Treatment.—Symptomatic treatment may be resorted to, but it is doubtful if satisfactory results will be obtained. This condition may

be prevented by the proper treatment or disposal of dogs as recommended under echinococcosis.

Pancreas

Little is known concerning the diseases of the pancreas. A condition known as multiple fatty necrosis occurs in swine and is thought to be the result of obstruction to the outflow of pancreatic juice. Sarcomas involving the pancreas in swine have been observed, but they were evidently not primary in that organ.

Peritoneum

Defects in the formation of the peritoneum are not common. Rarely cystic inclusions or exclusions may be observed.

INJURIES

The peritoneum is occasionally injured in swine. The injuries may be inflicted during a surgical operation or they may be produced accidentally. The result of injury of the peritoneum varies with the location and the extent and nature of the injury; which may consist of a bruise of the peritoneum, in which case there is a local inflammatory disturbance; a puncture of the peritoneum, resulting in general peritonitis; or a laceration of the peritoneum, permitting eventration.

The results of violence from the external surface are self-evident, but the injuries may be inflicted by foreign bodies in the alimentary canal. In such cases there is more or less digestive derangement and local or general peritonitis.

Treatment.—Medicinal treatment may be applicable when the peritoneum is intact, but in lacerations of the peritoneum surgical interference alone is of value.

ASCITES

Ascites is a condition resulting from the accumulation and retention of excessive quantities of lymph or diluted lymph in the peritoneal cavity. The peritoneal cavity is in reality a large lymph space.

Ascites is very rare in swine.

Etiology.—Ascites is caused by an excessive outpouring of lymph into or a diminished absorption of lymph from the peritoneal cavity.

The lymph escapes from the blood capillaries in the subserosa on to the surface of the peritoneum. The usual causes are obstructed portal circulation, which may be due to disturbances of the liver, valvular defects of the heart, chronic nephritis, or direct pressure upon the portal vein.

Lesions.—Enlarged abdomen, due to the accumulated fluid in the peritoneal cavity. The fluid is thin, limpid, and is noncoagulable. The lesions of the primary cause may also be observed.

Symptoms.—A pendulous abdomen associated with digestive disturbances and malnutrition are the principal evidences of this disease.

Treatment.—Treatment is of little value. Temporary relief may be obtained by paracentesis abdominis.

PERITONITIS

Inflammation of the peritoneum is not of as common occurrence in swine as it is in horses, and the disease is less fatal in swine than it is in most other animals.

Etiology.—The peritoneum of the pigs is very resistant to infection. Foreign bodies frequently become imbedded in the peritoneum and establish a general inflammatory disturbance. Cesarean section, spaying of sows, and the castration of ridgling boars is in some cases succeeded by infection and fatal peritonitis. Parturition and particularly dystocia cases are prone to develop peritonitis. Septic metritis is sometimes associated with peritonitis as a result of extension of infection. Occasionally an ascarid may perforate the intestine and produce sufficient irritation to produce inflammation of the peritoneum.

Lesions.—Peritonitis may be serous, fibrinous, hemorrhagic, purulent, septic, or tubercular; local or general; acute or chronic. The lesions will vary according to the type of inflammation. There is first tumefaction, congestion, loss of gloss of surface, and exudation. The serous exudate is sticky, serum-like, and may be tinged with blood; the fibrinous exudate coagulates and causes adhesions; the hemorrhagic exudate is of a bloody appearance; and the purulent exudate is composed of pus. Septic peritonitis is associated with the accumulation of a putrid material upon the peritoneal surface. There may also be evidence of injury, or metritis, and probably some intestinal content in the peritoneal cavity. Chronic peritonitis

is associated with the proliferation of fibrous tissue and usually greater or less adhesions of the visceral and parietal peritoneum.

Symptoms.—Acute peritonitis is associated with abdominal pain, the severity of which depends upon the extent and intensity of the inflammation. The pain may be manifested on palpation of the abdomen. The affected animals have a "tucked up" appearance; the appetite is diminished or perhaps wanting. There is a rise of temperature and a rapid, wiry pulse. The animals are uneasy and restless and grunt when forced to move. Constipation is present. The acute type of peritonitis is usually of short duration, the animals in many instances dying within forty-eight hours, especially when the condition is the result of an operation.

Animals affected with chronic peritonitis may show some digestive derangement or there may be no evidence of disease.

Treatment.—Remove the cause, and the further treatment will depend upon the cause and nature of the lesions. In all cases the bowel movement should be diminished or inhibited by the use of opiates. If the disease is the result of injury, surgical interference and the rational application of antiseptics is indicated. If the animals eat they should receive only liquid foods easy of digestion.

TUMORS

Some cases of peritoneal tumors in swine have been reported. The fibroma of swine is usually benign; it may be tabular or pedunculated. Sarcoma, endothelioma, and carcinoma also have been observed, the first being the most common.

The above-mentioned tumors are pathologically identical to the same type of tumors observed elsewhere in swine or in other animals, and they produce practically the same results, with the possible exception that the malignant tumors are not so fatal as in some other animals, particularly in the human.

PARASITES

The cystic form of the Tænia echinococcus (echinococcosis) is probably the most common parasitic invader of the peritoneum of swine. The description of these cysts will be found under the discussion of parasites of the liver.

The Cysticercus tenuicollis is occasionally observed involving the peritoneum of swine, although in the central United States these

cysts are much more common in sheep. The cysts contain only one tapeworm embryo, differing in this particular from the cysts of the Taenia echinococcus. They have a double membrane, the embryo being suspended in a thin, watery fluid that fills the cyst, which may attain the size of an English walnut.

Stephanurus dentatum, both in the adult and larval stage, may be found in relation to the peritoneum. The lesions they produce in the peritoneum are the same as those produced by this parasite elsewhere in the body.

The Ascaris suum may bore through the intestine and be found in the peritoneal cavity. As they pass out of the intestine they carry various bacteria with them and possibly also permit the escape of some intestinal content which is always teeming with bacteria. Thus infectious, usually septic, peritonitis results.

CHAPTER III

DISEASES OF RESPIRATORY ORGANS

Anatomical Consideration

- Respiration
- Nose
  - Epistaxis
  - Rhinitis
    - Catarrhal
    - Infectious
    - Bull nose
  - Tumors
- Larynx
  - Laryngitis
    - Catarrhal
    - Croupous
  - Tumors
- Trachea
  - Malformation
  - Stenosis
  - Tracheitis
  - Tumors
- Bronchial Tubes
  - Stenosis
  - Bronchitis
    - Catarrhal
    - Parasitic
- Lung
  - Atalectasis
  - Emphysema
  - Edema
  - Hemorrhage
  - Pneumonia
    - Catarrhal
    - Croupous
    - Purulent
    - Chronic
    - Septic
  - Tumors
  - Parasitic
- Pleura
  - Hydrothorax
  - Hemothorax
  - Pneumothorax
  - Pleurisy
    - acute
    - chronic
  - Tumors
- Spasms of Diaphragm

Anatomical Consideration

Snout.—The snout is formed by a fusion of the upper lip and the structure that corresponds to the nose in other animals. It is short and cylindrical. The skin of the snout is thin and quite sensitive. The nostrils are open on the flat surface of the snout. They are round and rather small and separated by the os rostri which is a prolongation of the septum nasi.

Nasal Cavity.—The nasal cavity varies in different breeds of swine, but in general it is long and narrow. It is divided behind a transverse plate into an upper part that communicates with the meatus of the ethmoid and a lower or respiratory portion. The nasolachrimal duct is in the posterior portion of the ventral portion of the cavity.

Larynx.—The larynx is long and has considerable mobility, due to the relatively loose attachments of the laryngeal cartilages. The vocal cords extend obliquely downward and backward. They are close together and hence the rima glottidis is narrow. Each vocal cord has an opening communicating with the laryngeal saccules.

Trachea and Bronchi.—The trachea extends from the larynx downward along the inferior portion of the cervical region into the thoracic cavity where it bifurcates, forming the bronchial tubes. The trachea is six to eight inches in length and contains about thirty-five incomplete cartilaginous rings.

There are two principal bronchial tubes, one being distributed to the right and the other to the left lung. A small tube is detached and is distributed to the right apical lobe of the lung. The principal bronchus of the right lung supplies branches to the cardiac and intermediate lobes and then continues into, and is distributed to the diaphragmatic lobe. The left principal bronchus supplies a branch that subdivides and is distributed to the apical and cardiac lobes and then continues and supplies the diaphragmatic lobe.

Lungs.—The right lung is usually divided into four lobes: apical, cardiac, intermediate, and diaphragmatic. The left lung has two distinct lobes and some anatomists describe a third indistinct lobe. In the left lung the diaphragmatic lobe is distinct. In the anterior portion the apical and cardiac lobes are usually fused.

The lung lobules are distinct but the interlobular tissue is limited.

Thyroid gland.—This gland is relatively large and is usually well removed from the larynx. The lateral lobes are two inches or more in length, are rather irregular and well united.

Thymus gland.—This gland is large in the pig, extending from the larynx into the thoracic cavity, but it gradually atrophies and is a mere rudiment in the adult.

Pleura.—The pleural sacs comprise a double fold of serous membrane, the outer or parietal layer being attached to the inner wall of the thorax, diaphragm, and is deflected downward from the dorsal median line. The inner or visceral portion is reflected over and closely attached to the outer surface of the lungs.

Respiration

By respiration is ordinarily understood the exchange of air in the lungs. The purpose of respiration is for the introduction of

oxygen and elimination of various waste products. The organs of respiration are the same as those of other mammals. Inspiration in swine is shorter than expiration and there is usually about one respiratory movement to four heart-beats. The total capacity of the lung of swine is relatively small in comparison to other animals of relative weight. About one-fifth to one-sixth of the total air that the lung is capable of retaining is replaced in each respiration. The frequency of respiration is increased by exercise or excitement. The native lard hog cannot withstand severe exercise, and this is the cause of so many heat exhaustions in these animals when they are moved on foot from place to place.

Nose

The habit of rooting predisposes the snout of swine to various kinds of injury regardless of the fact that this organ has been designed for such purposes. Ringing of swine produces an injury that in some instances is difficult to correct.

EPISTAXIS

Nose bleeding is not a disease primarily, but is usually a symptom of some other disease or abnormal condition. Epistaxis occurs rather commonly in swine.

Etiology.—True epistaxis is a result of the escape of blood from some of the blood vessels of the nasal chambers or related cavities. It is a very common symptom in hog cholera and swine plague, and has been observed in cases of anthrax. The condition is sometimes associated with ulceration of the Schneiderian membrane regardless of the cause of the ulcers. In some instances, it may be due to mechanical injuries of the mucous membrane.

Lesions.—Except in epistaxis resulting from trauma, the lesions of the primary condition are more prominent than those associated with the hemorrhage.

Symptoms.—Escape of blood, usually from the nostril, is the principal evidence of epistaxis. The escaping blood may be scarlet red or dark red, depending upon whether the blood is escaping from an artery or a vein. Epistaxis can be distinguished from pulmonary hemorrhage by the fact that the discharged blood from the latter is frothy.

Treatment.—Epistaxis is usually not fatal. It is difficult to treat

in swine because of the small size of the opening of the nostril. Hydrogen peroxide may be introduced by means of a syringe, and this gives immediate and sometimes permanent relief. A solution of adrenalin chlorid gives similar results.

CATARRHAL RHINITIS

Catarrhal rhinitis is a common condition in swine. It occurs in pigs and mature swine. It is probably more prevalent in the breeds of swine that have dished faces. This, like other inflammatory disturbances of the respiratory tract, is more common in early spring and late fall than in summer or winter. Catarrhal rhinitis may be acute or chronic.

Etiology.—Catarrhal rhinitis in swine is usually caused primarily by some non-infectious irritant, although in the later stages microbian agents may, and frequently do become of first importance. Swine that are permitted to sleep in straw piles or manure heaps during cold weather are very prone to rhinitis because they become heated and when they come out in the morning they chill. Ammonia fumes may prevail in manure heaps in sufficient quantities to be irritating when inhaled. Dust when inhaled produces an inflammation of the Schneiderian membrane. In general, catarrhal rhinitis is caused by inhalation of irritating substances, such as dust, ammonia or other chemicals and by sudden temperature changes. This condition is frequently found associated with other diseases, particularly swine plague and hog cholera.

Lesions.—Acute catarrhal inflammation of the nasal mucosa is characterized by congestion and tumefaction of the mucous membrane. This membrane is at first dry, but later varying quantities of serous fluid and mucus escape upon the surface of the mucosa and are discharged, some of the discharge accumulating upon the external surface of the nostril. The exudate may become infected and invaded by leukocytes, the discharge thus becoming mucopurulent or purulent. Chronic catarrhal inflammation may produce a hypertrophy or atrophy of the nasal mucosa. The hypertrophic change is due to the production of large quantities of fibrous tissue in the submucosa. The mucosa thus becomes thickened, dense, and leathery. The increased volume of the mucous membrane may so diminish the cavities of the nose that breathing is difficult. In other instances the mucous membrane atrophies,

the nasal cavity thus becoming larger. It is not unusual to find desiccated discharge adhering to the mucosa. In either the hypertrophic or atrophic forms of chronic catarrhal rhinitis there may be ulceration of the mucous membrane. When such ulcers occur they usually involve only the mucous membrane.

Symptoms.—Sneezing frequently repeated is usually the first symptom evidenced in catarrhal rhinitis. Within a few hours after the onset the affected animal appears dull or sluggish and there is a discharge from the nose of a serous, mucous, seromucous, purulent or mucopurulent substance, the character of the discharge depending upon the stage of the disease. There may be some rise of temperature and if there is much swelling of the nasal mucous membranes, breathing will be labored. Congestion of the conjunctival mucosa is frequently an associated condition.

Treatment.—Remove the cause and if the condition has not persisted until it has become chronic there will be a speedy recovery. Dusty pens should be sprinkled, old straw piles burned and manure heaps removed. The swine should be provided with clean pens or preferably pastures, when the weather will permit. Hog houses should be properly ventilated. Slop feeds are preferable. Dusty feeds should be eliminated.

Medicinal treatment is not easily applicable for the relief of porcine catarrhal rhinitis. General digestive tonics may be of some value. Animals affected with advanced stages of the chronic form of this disease had best be put into a marketable condition, if possible, and sold for slaughter.

INFECTIOUS NASAL CATARRH (MALIGNANT CATARRH)

An infectious nasal catarrh of swine occurs enzootically in some foreign countries and a similar clinical affection occurs in some sections of the United States. This disease is usually confined to pigs less than six months of age.

Etiology.—In 1906, the Bacillus pyocyaneus was identified by Koske as the causative factor, although the infectious nature of the disease was recognized as early as 1890. The Bacillus pyocyaneus is found in manure heaps and mulched soils; it gains entrance to the nose while the swine are rooting and is readily transmitted from a diseased to a healthy animal by means of the nasal discharges.

Lesions.—This disease is characterized by an intense inflammation

which causes a marked congestion of the mucosa and not infrequently a hemorrhagic inflammation. The lesions extend and involve the sinuses and the ethmoidal cells, and there may be involvement of the optic and olfactory nerves, of the cerebral meninges, and of the brain itself. The usual lesions in the last-mentioned structures consist of hemorrhages beneath the sheath of the optic and olfactory nerves, congestion of the meninges, and edema of the cerebral tissue proper. Various changes may be observed in other internal organs as a result of high temperature and possibly also of metastasis of the infecting agent.

Symptoms.—High temperature and inappetence are usually the first symptoms of the disease. Sneezing, and vigorous rooting or rubbing the nose, are followed by epistaxis, edema of the snout, and difficult breathing. The affected animals may be blind in one or both eyes, and if there is meningeal involvement the pigs will evidence extreme excitement and finally die in a comatose state. The disease may result fatally in a very short time, its course in the most fatal epizoötics being from three to six days. A chronic or less fatal form has been observed in which the course of the disease varies from one week to several weeks, and some of the animals may recover.

Treatment.—In the acute form of infectious nasal catarrh treatment has not been successful. From the experience of those veterinarians where this disease prevails it seems best to recommend destruction of all affected animals. An antitoxin may be prepared and used to offset the injurious influences of the toxic substances produced and eliminated by the Bacillus pyocyaneus. Prophylactic sanitary measures should be instituted and rigidly enforced on premises where this disease abounds.

TUMORS

Various tumors have been observed in the nasal cavity of swine or involving some related structure. Almost all of these tumors have been of the benign type and therefore interfere only mechanically. Pedunculated fibromas are not so common in swine as in some other animals.

Larynx

CATARRHAL LARYNGITIS

Inflammatory disturbances of the larynx are relatively common in swine but are not of sufficient gravity to warrant a lengthy discussion.

Etiology.—Undue exposure and inhalation of suspended or gaseous irritants are common causes of laryngitis. In swine, as in other animals, laryngitis is rarely a distinct process but is a condition associated with inflammatory disturbances of the pharynx, or trachea, and therefore the inflammatory process of the larynx is frequently an extension from an adjacent structure. Chronic laryngitis results from the same causative factors as the acute type, being merely extended over a longer period.

Lesions.—Laryngitis in swine is generally of a catarrhal type and may be either acute or chronic, although an occasional case of croupous laryngitis occurs. The lesions observed are practically identical with the usual lesions of this type of inflammation.

Symptoms.—The principal symptom of laryngitis is a cough, which is at first dry, later moist, and always painful. The cough may become convulsive. In the intense acute attacks there will be rise of temperature and probably inappetence. By palpation the laryngeal region will be found supersensitive.

Treatment.—Provide sanitary surroundings and if the patient is inclined to eat, give sparingly of easily digested slops. Medicinal treatment is so difficult to apply that frequently more harm than good is the result.

CROUPOUS LARYNGITIS AND TRACHEITIS

Croupous inflammation of the mucosa of the larynx and trachea is relatively common. It is most common in swine fed in self-feeders.

Etiology.—The specific cause of croupous inflammation of the membranes of the larynx and trachea have not been identified. The primary cause of this condition is probably mechanical injury from the awns or beards of barley or other grains. Such foreign substances are obtained by swine from ground barley in which quantities of awns have been left because of threshing while damp or wet. Eating from self-feeders appears to favor inhalation of dust, beards, etc.

Lesions.—The principal lesion consists of a croupous exudate which is a tough grayish membrane, usually found in the upper portion of the trachea and the larynx. This membrane is so extensive in some cases that it practically fills the lumen of the trachea and larynx. This membrane may become detached and lodge in the larynx, caus-

ing death from suffocation, or it may pass down the trachea and occlude the bronchial tubes.

Symptoms.—The first symptoms manifested are sneezing, coughing and dyspnea. As the disease progresses the cough becomes very hoarse and croupy. If the condition is not intensive the symptoms continue and the animals become unthrifty and emaciated. In those cases in which the croupous membrane becomes detached and lodges in the larynx, there will be extreme dyspnea and frequently death by suffocation.

Treatment.—Prevention is far better than treatment; in fact, there is little that can be done to relieve an affected animal. Ground barley or other grains in which there are quantities of awns should not be used for feed.

TUMORS

Laryngeal tumors are rare. However, pedunculated fibromas have been observed, and epithelioma has been reported.

Trachea

MALFORMATIONS

A case occurs occasionally in which the esophagus forms a union with the trachea. Pigs so affected usually die soon after farrowing.

STENOSIS

Congenital tracheal stenosis may occur in swine, but is relatively rare. Acquired stenosis is also rare, because of the protection of the trachea from external injuries.

TRACHEITIS

This inflammatory disturbance is usually associated with laryngitis or bronchitis, and partakes so closely of the nature of these latter affections that further description will not be given.

TUMORS

Tracheal tumors are not common in swine, though fibromas and myxomas of the benign tumors have been observed.

Bronchial Tubes

The principal malformations of the bronchial tubes consist of an irregularity in the distribution of the branches of those tubes, but

as a rule this produces little or no inconvenience to the animal and is therefore of scientific interest only.

STENOSIS

Bronchial stenosis is rarely common in swine. The condition may affect either the large or small tubes. Bronchial stenosis is probably most frequently the result of a diseased condition of the bronchial mucosa, such as catarrhal inflammation, ulceration, tuberculosis, parasitic invasion, or mechanical injury due to some foreign body, as a needle or a nail.

CATARRHAL BRONCHITIS

The principal inflammatory disturbance of the bronchial tubes is of a catarrhal nature, at least in the beginning. Catarrhal bronchitis may be either acute or chronic.

Etiology.—Undue exposure to inclement weather is one of the principal causes of bronchitis. Inhalation of dust-laden air is also an important causative factor of inflammation of the bronchial tubes. Infection is in many instances an auxiliary of other causes and streptococci bacillus pyocyaneus are many times the primary causes of bronchial catarrh. This condition may be associated with other diseases, such as swine plague or hog cholera.

Chronic bronchial catarrh results from the action of the same causative factors that produce acute catarrh, but the irritants are usually less intense and act for a longer time.

Lesions.—There is congestion of the affected mucosa, which later becomes covered with mucous or with a mucopurulent discharge. In extreme cases the discharge may be tinged with blood and become purulent. When the disease process involves the capillary bronchial tubes there is usually more or less emphysema, due to obstruction of the tubes with exudate which prevents the escape of air from the air cells. There may be areas of atelectasis which project beyond the surface of the lung and are of a darker color than the lung.

Chronic bronchial catarrh is characterized by the presence of mucous, purulent, or even caseous material in the bronchial tubes, and by fibrous proliferation in the submucosa which may result in an attenuation of the mucosa. Dilatation or bronchiectasis is a common lesion, particularly in the dependent parts of the lung, in chronic catarrhal bronchitis. In long-standing cases there may be peribron-

chitis, evidenced by fibrous proliferation around the bronchial tubes, which may extend into the pulmonary tissue.

Symptoms.—The principal symptom of bronchitis is a cough which in the beginning is dry but later becomes moist. The cough may become convulsive. As the disease progresses a nasal discharge becomes evident, which is at first of the nature of mucus but later becomes mucopurulent or purulent. Râles may be detected in thin swine, or possibly in any of the bacon breeds, but the chest wall of other swine is usually so thick that it practically prohibits the recognition of pulmonary conditions. There is usually some rise of temperature in the beginning, but this may subside. The appetite may be diminished.

Treatment.—Removing the cause and providing sanitary surround-

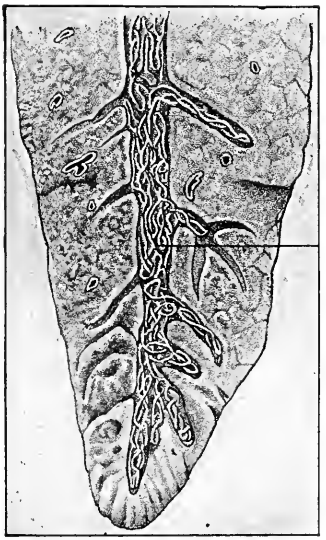


Fig. 29. Bronchial tube of hog with lung worms. (Ostertag.)

ings will probably do more than medication to relieve this condition. Supply easily digested foods. If the swine can be controlled easily and placed in a piggery that can be made practically airtight, the animals may be successfully treated with medicated vapors, using such agents as oil of eucalyptus.

BRONCHIAL AND PULMONARY STRONGYLOSIS

Pulmonary strongylosis and bronchitis are very common in swine in the United States; however, the infestation is only rarely of sufficient extent to produce serious damage. The lungs from a thousand swine were inspected in a Kansas City abattoir and sixty per cent of them contained pulmonary Strongyli in such numbers that the lesions could readily be observed by gross examination.

Etiology.—Metastrongylus apri is the causative parasite of porcine pulmonary strongylosis. It is a white or brownish-white thread-like worm from one inch to one and a half inches in length. The adults inhabit the middle-sized and small bronchioles, usually in the posterior superior part of the lung, although they may be found elsewhere in the lung. The ova are carried out from the lung in the discharge and may pass out directly or pass into the pharynx and be eliminated in the feces. The exact life cycle is not known, but it is probable that the ova hatch and undergo several moults before regaining the animal body. The parasites gain entrance to the animal body in the food or water, infestation of swine being accomplished. Young pigs are most susceptible; however, the parasites have been identified in swine of all ages. After the parasites gain entrance to the animal body they begin to migrate, some of them ultimately reaching the bronchial tubes. The exact route of migration is still a disputed question, but they pass either by way of the pharynx through the larynx to the bronchial tubes, by way of the blood stream, or directly through the tissues.

Lesions.—The principal lesions in swine are found in the posterior lobes and in the superior part of those lobes. At first the lesions are confined to centers, or foci, which are coneshaped and usually atelectatic, though they may protrude and be of a doughy consistency. In a later stage these foci are found to contain mucopurulent, purulent, or even caseous substances in varying quantities in addition to from one to many Strongyli and their ova. Similar discharges will be found in the bronchial tubes and even in the trachea, and occasionally disintegrated vermes and their ova will be found in the expectorate. There may be bronchiectasis, but this condition is not common. The visceral pleura may show evidence of chronic inflammation.

Symptoms.—The period of incubation varies from four to eight weeks. Although this condition is very prevalent, the infestation

is usually limited and fatalities from this disease are exceptional. The primary symptom is a cough, which usually involves several animals at once and becomes more frequent as the disease progresses. In fatal or severe cases the cough is paroxysmal, the animals sometimes falling to the ground from exhaustion and lack of air. A sticky, adhesive discharge prevails and accumulates upon the nostrils, respiration becomes difficult, and a distinct wheezing sound can be heard. The temperature may be increased from one to three degrees Fahrenheit. Emaciation is rapid. Edema of the dependent parts occurs, and the animals become weak and finally die of exhaustion. The course of the disease varies from one to three or four months. The diagnosis should be based upon the history of the outbreak, the number of animals involved, the character of the cough, and finally upon the detection of ova and parasites in the discharges and the presence of parasites in the lungs on autopsy.

Treatment.—This disease is difficult to treat because of the location of the parasites and the difficulty of controlling swine. The only rational method consists of the intratracheal injection of some agent that will destroy the parasites, or of the inhalation of medicated vapors. These methods are not easily adapted to the treatment of swine, particularly the intratracheal injections. Medicated vapors may be used, providing the swine can be confined in an airtight room.

Further infestation should be prevented by the proper disposal of the various excretions from the infested animals. The pens should be thoroughly cleaned and some efficient parasiticide applied. If the infestation is in pasture land, it will be necessary to change pasture, keeping all swine away from the known infested pasture for at least a year, and for two years if possible.

The exact procedure of medicating by inhalation will depend upon the available facilities. The medicaments available are phenol, creosote, various coal tar derivatives, turpentine, oil of eucalyptus, etc. Hogs may be medicated by vapors during the winter months by first removing all litter from the hog house or box stall in the horse or cattle barn, bedding six or eight inches deep with clean hay or straw. The medicament is then added to a sufficient quantity of hot water (six or eight gallons), and the mixture then sprayed over the fresh bedding and the hogs driven in at once, and they will inhale a sufficient quantity of the vapors to be of considerable bene-

fit. This method of medication may be accomplished by providing an oil stove and the medicament vaporized and conducted through a flue into the closed hog house containing the swine.

Lungs

ATELECTASIS

This is a condition of collapse of the lung; the absence of air in the lung, and may be either congenital or acquired. The lung of the fetus is always atelectatic before birth. This is one means of determining a still birth, and is often useful as evidence in legal cases. Partial congenital atelectasis may be the result of obstruction of a bronchus with meconium or mucus; it may also be the result of excessive extrathoracic pressure. Acquired atelectasis may be due to compression of the lung by inflammatory exudate (pleuritic effusions), edematous transudate, or forward displacement of the diaphragm. It may also be due to obstruction of the bronchus, the air contained in the air cells being absorbed, permitting them to collapse. This condition may occur in rickets and in pig scour.

Lesions.—The affected lung tissue collapses and does not crepitate. It is red or reddish-brown in color, feels dry, is tough, and sinks in water. If the condition is of long standing, the affected area becomes darker in color and is designated cornification. In some instances the atelectatic areas become spleen-like, due to the development of fibrous tissues, and this is termed splenization.

Atelectasis diminishes the breathing capacity, which is the only symptom characterizing the condition. Small areas of the lung will not produce visible symptoms. This condition is usually associated with other disease processes, the symptoms of which mask those of atelectasis.

Atelectasis occurs in the lung of swine as a result of swine plague, hog cholera, bronchitis, pneumonia, and pleurisy, as well as of other less important diseases.

EMPHYSEMA

Pulmonary emphysema has been observed in swine but is not of common occurrence. It is due to conditions that favor the inflation of the lung with excessive quantities of air. Bronchopneumonia is occasionally associated with emphysema. The affected areas are soft, spongy, anemic, and project beyond the surface of the lung.

EDEMA

Pulmonary edema is not common in swine kept under ordinary conditions, but it is often found in those that are hyperimmunized for the production of anti-hog-cholera serum. Those having experience as serum producers occasionally have a swine die of pulmonary edema at the time or immediately after the intravenous injection of quantities of virulent blood.

In comparison to their size, swine have a relatively small lung. The virulent blood that is used in hyperimmunizing is defibrinated but contains both the red and white blood cells, some of which are disintegrated. Large quantities of this defibrinated blood, containing corpuscles in various stages of disintegration as well as the virus, are introduced into an ear vein. The first capillary system it would pass through is in the lung where, no doubt, more or less obstruction of capillaries is effected and the virus, or some chemical ingredient of the blood, may cause an increased permeability of the blood vessels and facilitate the outpouring of the serum.

Lesion.—The lungs are engorged with blood. The air cells contain varying quantities of serum, the lung thus becoming soggy and edematous. No other lesion of any significance is found.

Symptoms.—The affected animal at first becomes restless and uneasy. There is increased respiration, soon followed by dyspnea, cessation of breathing, and death. In some cases all these symptoms occur within a few minutes and during the time that the virus is being introduced. If the injection is stopped instantly when the first symptom becomes evident some of the affected swine will recover, but in some of them the various symptoms occur, succeeded by death, even though the introduction of virus be stopped when the first symptom appears. An occasional case occurs where the swine will show no discomfiture at the time of the injection of the virus, but may be found in distress from a few minutes to an hour later. In such cases, death will usually result.

Treatment.—Thus far no treatment has been found that appears to be of value. It is possible that centrifuging the virus will overcome the difficulty.

HEMORRHAGE

Pulmonary hemorrhage is not common in swine as a primary disease. It has been reported as occurring in fattened swine that are

driven to market, especially when they become very hot. It is rather common as a secondary condition in acute cases of pneumonia, swine plague, and hog cholera.

Cause.—Engorgement of the lung capillaries, due to overexertion, excessive heat, or disease, is the chief cause of hemorrhage. Weakening of the vessel walls due to malnutrition, which occurs in some infective diseases, is another cause.

Diseased lobes of lungs

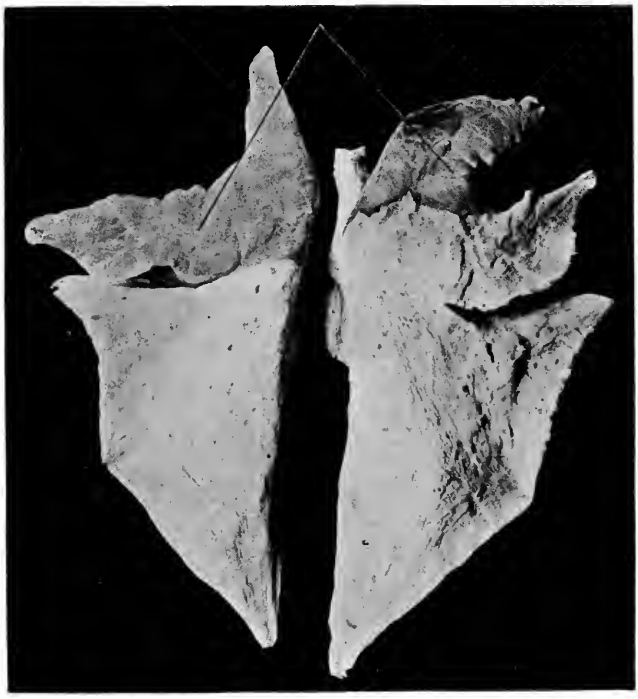


Fig. 30. Hog lungs with inflammation of anterior lobes as a result of chronic swine plague. (Ostertag.)

Lesions.—Almost all cases of hemorrhage of the air passages posterior to the larynx are designated hemoptysis, or pulmonary hemorrhage, and it is difficult in some instances to differentiate tracheal or bronchial hemorrhage from pulmonary hemorrhage. If the hemorrhage is primary the escaped and escaping blood is practically all that will be observed. The blood that escapes from the lung or smaller bronchial tubes will contain more entangled air, that is, be

more frothy than that coming from the large bronchi and the trachea. In secondary pulmonary hemorrhage the lesions of the primary disease will also be evident.

Symptoms.—If the extravasate is limited in quantity it may be absorbed and no visible symptoms become evident. Escape of frothy blood from the nose and mouth characterizes hemoptysis. In cases where there are large quantities of blood escaping there will be more or less bronchial obstruction and consequently difficult breathing, and the animal may become weak from loss of blood. The condition may terminate fatally or the affected animal, in those cases where the hemorrhage is limited, may recover.

Treatment.—Keep the affected animals cool, and where they will be least excited.

PNEUMONIA

Inflammation of the lung is not of common occurrence in swine as a primary condition but it is frequently associated with some other disease.

Practically all types of pneumonia based upon pathologic classification occur in swine. The following types will be described: catarrhal, croupous, purulent, and gangrenous.

Catarrhal Pneumonia

Catarrhal pneumonia is a lobular involvement characterized by occlusion of the air cells, with exudate and desquamated epithelium.

Etiology.—Catarrhal pneumonia is practically always a sequel of bronchitis and is therefore produced by the same causative factors. Bacillus pyocyaneus may cause catarrhal pneumonia. Catarrhal pneumonia is one of the characteristic lesions of swine plague due to the Bacterium suisepticus. (Description will be found in Chapter VIII.) Bronchopneumonia is occasionally secondary to other diseases, such as hog cholera or septicemia.

Lesions.—The inflammatory process is confined to a lobule or a group of lobules. As the disease progresses, other adjacent lobules may become involved, the affected areas thus becoming confluent and larger. In the beginning the affected areas are hyperemic. The alveoli soon become filled with inflammatory exudate which is at first fluid but later coagulates and becomes dry, the diseased lobules thus becoming solid. These areas are first red in color, but early become brown, gray, then yellow or yellowish-white, and if the con-

dition persists abscess formation may occur. Bronchitis is usually associated with bronchopneumonia and in such cases the lesions characterizing bronchitis would also be present.

Symptoms.—Catarrhal pneumonia in swine is extremely difficult to differentiate from bronchitis because of the inability to efficiently auscultate or percuss the thorax. Catarrhal pneumonia offers the same general symptoms that have been noted in bronchitis, except that pneumonic symptoms are usually more intensive than those of bronchitis. Catarrhal pneumonia has no definite course, the length or duration of the disease depending upon the cause, extent of the

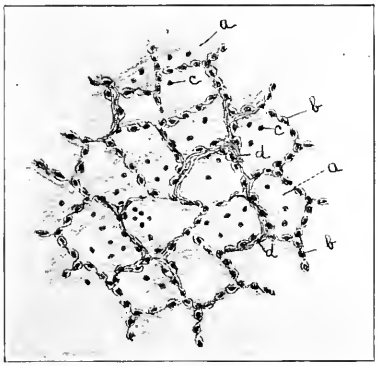


Fig. 31. CATARRHAL PNEUMONIA. A, mucous collection in alveolus; B, alveolar wall; C, desquamated epithelial cells; D, fibrous tissue formation.

disease, and the resistance of the affected animal. The disease is most fatal in young swine.

Treatment.—Medicinal treatment other than inhalation of medicated vapors is of little or no value. Proper sanitary conditions should be provided, and the affected animals should be given easily digested, wholesome food in sufficient quantities to build up the body and maintain strength. If the causative factor is an infection, isolation and proper quarantine regulations should be enforced.

Croupous Pneumonia

Croupous pneumonia is a disease involving lobes or large lung areas and is characterized by the presence of a hemorrhagic exudate in the air cells. It is not a common primary condition in swine, but is frequently associated with hog cholera.

Etiology.—Many predisposing factors enter into the causation of this disease, such as undue exposure or inhalation of irritating gases, but it is probable that the specific active cause is microbian.

Lesions.—Croupous pneumonia is characterized by the regularity of the successive changes that occur in the affected portion of the lung. The disease usually involves the dependent part of the lung and is essentially lobar, but more or less than this amount of lung may be involved. The various stages that occur in the lung are as follows: congestion, red hepatization, gray hepatization, and resolution. These stages occur in the order mentioned, and there is no distinct line of demarcation between each succeeding stage. The length of duration of each stage is subject to variation, but on the whole is quite constant. The congestive stage is of about twenty-four hours' duration. During this stage the affected portion of the lung is engorged with blood. In the beginning the air cells contain air but as the disease progresses the alveolar capillaries begin to leak or there is a hemorrhagic exudate into the alveoli. Red hepatization begins when exudation is evident, and this stage persists for from three to five days; the area affected is red, dense, heavy, and liver-like. Gray hepatization is characterized by a gray or yellow coloration of the affected lung. This stage succeeds red hepatization and is due in part to the substitution of leukocytes for the coagulated hemorrhagic exudate that characterizes red hepatization and in part to chemical change of the hemoglobin of the extravasated red blood cells in the hemorrhagic exudate. The lung tissue affected with gray hepatization is gray in color, dense, heavy, and cuts like liver tissue. Gray hepatization persists for from three to five days, and when the alveoli are relatively free of exudate and leukocytes the lung is said to be in a stage of resolution, which includes that period of time during which the air cells are freed of all inflammatory products and return to the normal condition. This is a variable period and depends upon the resistance of the affected animals. The lung, during this stage, contains some inflammatory products in the beginning and later small quantities of mucus and debris, but in the final stages the lung is practically normal.

Symptoms.—Inappetence, high temperature, and increased respiration and heart action characterize croupous pneumonia. On the second or third day a "prune-juice" nasal discharge may be observed

which later becomes mucous or mucopurulent. The affected swine are dull, listless, and will probably cough more or less when agitated.

Treatment.—Sanitary surroundings, good water to drink, and an abundance of fresh air without drafts are prerequisities in the treatment of pneumonia. Laxatives should be given to prevent constipation. Heart stimulants may be required, but should not be administered except when necessary, as indicated by a rapid, weak pulse.

Purulent Pneumonia

Purulent pneumonia is an inflammation of the lung characterized by the formation of pus. This condition is relatively common in young pigs, although it may occur in swine of any age.

Etiology.—Purulent pneumonia is of bacterial origin. The pyogenic Micrococci, Bacillus pyocyaneus, and tubercle bacillus are the most frequent causative factors of this condition. These organisms may be inhaled direct but they are more frequently introduced into the lung from elsewhere as emboli. Purulent pneumonia in old swine is therefore frequently associated with pyemia, abscess formation, or purulent metritis. Several cases have been observed in the carcasses of swine that had previously been hyperimmunized intramuscularly for the production of anti-hog-cholera serum.

Lesions.—The principal lesion is suppuration, the centers of which vary in size and number but in the beginning are relatively small and in the earlier stages are not encapsulated but are surrounded by a zone of lung tissue intensely infiltrated with cells. As the condition progresses a circumscribing capsule is formed and the pus becomes thicker, and if the capsule is not destroyed the contained pus becomes caseous and may later become calcified. Should the capsule of a suppurative center become eroded the contained pus may infiltrate the adjacent lung tissue or discharge into a bronchial tube, the original suppurative center thus becoming a cavity. The pleura covering superficial suppurative centers usually shows some involvement.

Symptoms.—The evidence of purulent pneumonia varies according to the nature and extent of the lesions. The presence of a single abscess may not cause any noticeable symptoms. General embolic purulent pneumonia is characterized by intense symptoms consisting of chills, fever, difficult and hurried breathing, uneasiness, and general distress. The discharge of pus within the lung tissue is evi-

denced by rise of temperature and the associated cardiac and respiratory disturbances.

Treatment.—No special line of treatment is of value. The animals should be placed in good quarters and cared for properly.

An infectious pneumonia of swine caused by streptococci has been observed in a few instances. The source of infection and the avenue of entrance has not been determined. The infection appears to be readily transmissible from animal to animal.

The lesions are pulmonary hepatization with a marked interstitial exudation and usually a purulent pleurisy. The symptoms consist primarily of respiratory disturbance and a rise of temperature.

All medicinal treatment that has been attempted has been of no value. It is probable that an autogenous bacterin would be useful, particularly as a preventive agent. Quarantine and the rigid enforcement of sanitary regulations have been found serviceable in checking the spread of the disease.

Septic or Gangrenous Pneumonia

Septic pneumonia is relatively common in swine. It has occurred enzoötically in swine affected primarily with forage poisoning associated with pharyngeal paralysis. Sometimes it is a sequel to croupous pneumonia.

Etiology.—The usual cause of septic pneumonia is the introduction of foreign substances into the lung. In cases of pharyngeal paralysis food escapes into the air tube. Drenching is another means by which foreign substances are frequently introduced into the lung. Thrombic obstruction of vessels supplying an area affected with croupous pneumonia favors the action of saprophytic bacteria, and hence putrefaction and the production of septic pneumonia. Abscesses sometimes become infected with putrefying organisms and produce septic pneumonia. The Bacillus necrophorus is active in the production of necrosis and putrefaction in the lung.

Lesions.—Necrotic centers are most frequently found in the dependent and anterior part of the lung. The foci vary in size from that of a pea to a baseball, and may be few or many. They appear dirty brown, red, or dirty white in color. When incised they are found to be soft, the content being semifluid in the early stages but later of a cheesy consistency. The surrounding lung tissue will be inflamed. In the beginning, an infiltration circumscribes the lesions,

but in the older lesions there may be a distinct capsule. Superficial necrotic foci may be associated with pleurisy.

Symptoms.—The first symptom evidencing septic pneumonia is the foul-smelling exhaled air. This symptom does not occur in all cases, as the escape of putrid odors is dependent upon the erosion and discharge into the bronchial tubes of necrotic putrid material. Rise of temperature accompanies practically all cases of septic pneumonia. The fever may be irregular and intermittent, the thermal disturbance depending upon absorption of septic products. In those cases of croupous pneumonia in which septic pneumonia is a sequel, the general symptoms will be the same, plus the offensive breath, as those observed in a case of croupous pneumonia. A microscopic examination of the nasal discharge will reveal the presence of shreds of disintegrated lung tissue in cases of septic pneumonia, which fact is of diagnostic value. The course of septic pneumonia is uncertain. The attack may terminate fatally in two or three days after the onset of the disease or, if the septic lesions are limited in extent, they may become encapsulated and the animal recover, the length of time required varying from a few weeks to as many months.

Treatment.—Remedial agents are of little, or no value so far as the septic process is concerned. The treatment of symptoms as they develop will be of some value. The animal should be given good care and sanitary surroundings provided.

Interstitial or Chronic Pneumonia

Interstitial pneumonia is a chronic condition characterized by proliferation of fibrous tissues. This condition is usually a sequel to chronic catarrhal bronchitis and chronic bronchopneumonia. It is observed in swine in those sections of the country where it is continuously dusty and in swine kept in quarters where slightly irritating gases prevail.

Etiology.—Constant inhalation of mild irritants, such as dust or chemical fumes.

Lesions.—Fibrous proliferation characterizes this disease. The fibrous tissue forms around the bronchioles, the process gradually extending and involving the alveoli. The bronchioles and alveoli also show evidence of catarrh. The affected lung is dense, and when cut offers more resistance than the normal lung. The degree of fibrous proliferation is quite variable in some instances; there is a

limited amount, and in other cases the normal lung tissue is displaced by fibrous tissue. Encapsulated suppurative or necrotic centers may be found.

Symptoms.—A persistent cough, associated with a limited but variable nasal discharge of a mucopurulent material, characterizes chronic pneumonia. The animals are usually unthrifty and emaciated.

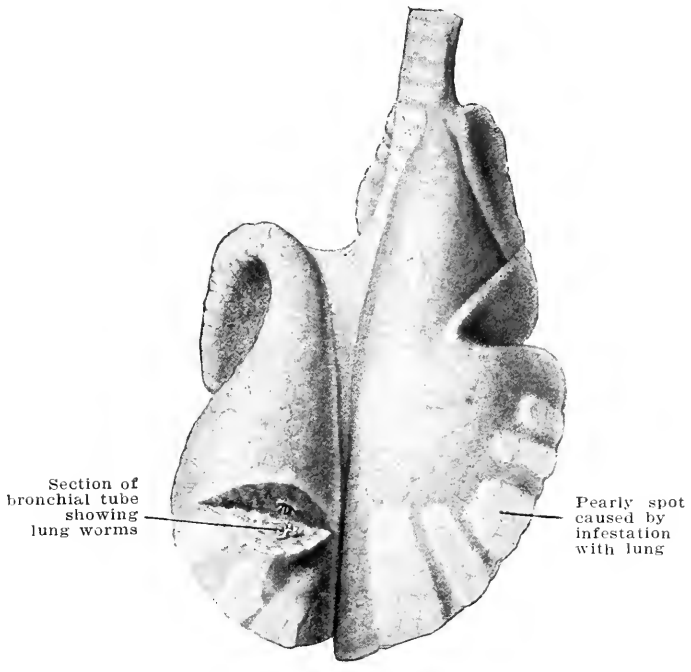


Fig. 32. Lung of hog with lung worms. (Ostertag.)

Treatment.—The cause should be removed and the animals properly housed and fed. Other than this, little can be done.

TUMORS

Various tumors have been encountered in the lungs of swine, but principally in autopsies or at abattoirs. Lung tumors of swine are similar to the same type of tumors of other tissues. Pulmonary neoplasms produce no typical symptoms by which they may be recognized clinically.

PARASITES

The principal pulmonary parasite is the Metastrongylus apri, which has been described under bronchial disorders and ascaridiasis.

Echinococcosis pulmonum is a common disease of swine. This condition is caused by the larval form of Tænia echinococcus. The cysts of pulmonary echinococcus are the same as those occurring in the liver.

Distomiasis, or invasion of the lung with flukes or Distoma, occurs but is not common in swine.

Pulmonary stephanurosis has also been observed, but is rare.

Parasitic nodules, the supposed results of invasion of some unknown parasite, are occasionally noted by veterinary inspectors, but there is little significance in such invasion as the lung is not edible, according to the meat-inspection regulations in the United States.

Pleura

Disease conditions of the pleura of swine are rarely recognized clinically, though some cases of pleuro-pneumonia may be determined by a clinical examination. Pathologic conditions of the pleura are occasionally observed by veterinary inspectors in the carcasses of swine that are slaughtered.

HYDROTHORAX

Hydrothorax is a condition resulting from the accumulation in the thoracic cavity of excessive quantities of serous fluid. It is of rather rare occurrence in swine.

Etiology.—Obstructed outflow of blood from the vena cava, with engorgement, is the principal cause of hydrothorax. Chronic disease of the cardiac valves and chronic pneumonia are the most common causes of obstruction of the outflow of venous blood from the vena cava. Tumors, abscesses, and malformed thorax may also be responsible for the causation of pneumo-thorax.

Lesions.—Accumulation of varying quantities of a pale yellow fluid in the thorax is the characteristic lesion, and in addition the primary lesions in the heart or lung are usually evident. The accumulated fluid will compress the lung.

Symptoms.—It is not possible in the beginning to detect any particular symptoms. Those produced by the accumulated fluid are frequently so overshadowed by the primary condition that it is not

possible to clinically diagnose hydrothorax until the advanced stages. There will be difficult respiration, and if the thoracic wall is not too thick a splashing sound may be noted synchronous with the heart-beat. An exploratory puncture with a small hypodermic needle will usually result in the discharge of serous fluid.

Treatment.—Temporary relief may be obtained by withdrawing the fluid from the cavity, but permanent results cannot be expected until the primary causative factor has been removed or overcome.

HEMOTHORAX

Hemothorax is a condition of the escape and accumulation of blood in the thoracic cavity. It is not a recognized clinical entity, particularly in relation to swine, yet it does occur, and is sometimes observed by inspectors of meat-food products.

Etiology.—This condition is observed in swine that have been transported to market, and the affected swine at the time of autopsy show evidence of having been injured, probably while in transit. The injury may be a puncture, wound, or a contusion.

Lesions.—Accumulation of blood in the thorax characterizes this condition. The blood may be coagulated, but it usually remains in the fluid state until the thorax is opened. The quantity of blood will depend upon the nature of the injury and the length of time elasping after its infliction. If the hemorrhage is of long standing, pigmentation of the pleura may be the only evidence remaining.

Symptoms.—The majority of animals affected with hemothorax show no symptoms. There may be paleness of the visible mucous membranes, weakness of the animal, and difficult breathing due to compression of the lung, but these symptoms are evident only in those cases in which the hemorrhage is extensive.

Treatment.—Medicinal treatment is of no value.

PNEUMOTHORAX

This is characterized by the accumulation of air in the thoracic cavity, a condition extremely rare in swine. The usual cause of the condition is injury in which the lung tissue is lacerated. The injury most frequently consists of fracture of a rib occasioned by improper handling in transportation.

The principal lesion observed consists of the primary injury. The thorax is found to contain air, and the lung is compressed.

PLEURISY

Pleurisy is inflammation of the pleura and may be serous, fibrinous, hemorrhagic, or purulent; acute or chronic. It is not a common condition among swine, at least in so far as the clinical recognition of it is concerned.

Acute Pleurisy

Etiology.—Acute pleurisy is practically always the result of infection, although there are many predisposing factors that are active in diminishing resistance and thus increasing the possibility of successful infection. The causative organisms may gain entrance to the pleura from the lungs through puncture wounds, through the blood, and through the lymph.

Lesions.—The pleura becomes hyperemic, tumefied, and dry. This stage is succeeded by an outpouring of a serous, fibrinous, or hemorrhagic exudate upon the pleural surface. Should the disease be due to the activity of pyogenic organisms the exudate will soon become purulent, and the future changes depend upon the nature of the exudate. Serous exudate may accumulate in quantities in the pleural cavity, and remain fluid although it may contain flakes of coagula. The fibrinous and hemorrhagic exudates coagulate early and produce greater or less adhesion of the visceral and parietal pleura. The hemorrhagic exudate is characterized by the presence of quantities of hemoglobin, which gives to it a red or blood color.

Chronic Pleurisy

Chronic pleurisy is characterized by the formation of varying quantities of fibrous tissue which produce permanent adhesions of the two layers of the pleura. There may also be considerable quantities of a fluid (serous) exudate in the pleural cavity, and there may be abscess formation, the pus being circumscribed by a definite capsule.

Symptoms.—Difficult breathing, each effort being accompanied by a grunt, and sensitiveness of the thorax, characterize pleurisy. In the acute cases there is inappetence, high temperature, and usually constipation. Chronic cases frequently show little evidence of disturbance.

The acute type has a relatively short course, terminating in recov-

ery, or in death within a few days. The chronic form may persist for weeks or even months.

Treatment.—Remove the cause of the trouble and establish sanitary conditions. The treatment of symptoms as they arise will be of some value. If an excessive quantity of serous fluid accumulates in the pleural cavity it should be withdrawn.

TUMORS

Pleuritic tumors are not common in swine. Fibromas have been encountered on a few occasions. Of the malignant tumors, endothelioma and sarcoma predominate, but are unusual.

Diaphragm

SPASM OF THE DIAPHRAGM (THUMPS)

Thumps is a condition caused by violent contractions of the diaphragm, and is relatively common in small pigs.

Etiology.—Spasmodic contraction of the diaphragm is caused by stimulation of the phrenic nerve. There are several different conditions that appear to be causative factors in the production of thumps. Disturbance of digestion is one of the most common associated conditions that results in thumps. Overloading of the stomach, improper food, gastritis and enteritis are conditions conducive to thumps. Pneumonia, hog cholera, and a variety of other diseases are frequently accompanied by thumps.

Symptoms.—There is a sudden jerking of the flanks. This symptom is very prominent when it occurs in a pig that is standing quietly, and there may be an accompanying sound that is quite distinct. There is regularity as to the frequency of the contractions; sometimes they occur in rapid succession, followed by a period of apparently a normal condition, then another series of contractions. Exercise and a full stomach aggravate the condition. The pig may become weak and emaciated. The course of the disease varies from one week to two or three months.

Treatment.—Good nourishing food and plenty of exercise are usually sufficient to correct spasms of the diaphragm. Small doses of from two to three drops of tincture of opium, administered with oil, will usually give temporary relief.

CHAPTER IV

URO-GENITAL SYSTEM

Anatomical Consideration

Kidneys
- Malformation
- Hydronephrosis
- Hemorrhage
- Fatty changes
- Calculi
- Congestion
- Nephritis — acute parenchymatous; acute interstitial; purulent; chronic
- Pyelonephritis — chronic interstitial
- Albuminuria
- Uremia
- Hematuria
- Parasites
- Tumors

Ureters

Bladder
- Malformation
- Hemorrhage
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- Calculi
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- Tumors

Urethra
- Stricture
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Prostate glands

Cowper's glands

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Ovary
- Malformation
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Fallopian Tubes

Uterus
- Malformation
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Vagina

Vulva

Mammary glands
- Mammitis: abscess; botryomycotic; catarrhal; parenchymatous
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- Persistent urachus
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- Infectious rhinitis
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Anatomical Consideration

URINARY ORGANS

The kidneys of swine are located beneath the transverse processes of the first four lumbar verterbrae. The left kidney frequently extends slightly anterior to the right one. The kidneys of swine have a smooth surface. They are approximately the shape of a bean and normally are of pale red color, although the shade is variable. They weigh about 8 ounces in a normal mature swine and are about 5 inches in length and 2 to 3 inches in width. The hilus occupies the concavity. The blood-vessels enter the kidney through the hilus and the ureter extends from it to the bladder. The ureters are relatively long and flexuous. The bladder is relatively large and projects well forward into the abdominal cavity.

The adrenals extend forward from the hilus of the kidney and are relatively thin, long and narrow.

GENITAL ORGANS

Boar

The genital organs of the boar consist of: scrotum, testicles, epididymis, spermatic cord, seminal vesicles, prostate gland and penis.

The scrotum is not distinctly outlined and is located below the anus. The testicles are comparatively large and elliptical in shape. The semen of the boar is usually thick and ropy in consistency, and in aged boars it may contain small masses or granules.

The spermatic cord is long and flexuous. The cremaster muscle is well developed. The seminal vesicles are large and extend well forward. In a mature boar these glands are about six inches in length and cover a large portion of the posterosuperior surface of the bladder. The prostate gland is located on the neck of the bladder beneath the seminal vesicles. In mature boars there are bulbo-urethral glands that are exceedingly large, located on either side of the pelvic portion of the urethra.

The penis of the boar is about 19 inches in length. It is devoid of a glans but the anterior extremity is spirally twisted. The urethra is slit like and situated near the extremity. There is a flexure located antero-inferiorly to the scrotum. The muscles of the penis are quite well developed.

The prepuce has a small opening that is surrounded by bristles. The preputial cavity is long and is incompletely divided into an

anterior and posterior portion. There are numerous lymph nodules in the posterior cavity. A cul-de-sac is usually present in the anterior portion. Calculi are of common occurrence in the cul-de-sac.

Sow

The genital organs of the sow consist of: ovaries, fallopian tubes, uterus, vagina and vulva. The mammary glands are usually considered as accessories.

The ovaries of the sow are usually irregularly lobulated due to follicles and corpora lutea. They are rounded but present a hilus

Fig. 33. Testicles of boar. O, testes; P,R, epididymis; S,T, spermatic cord. (White's Castration.)

that contacts the fimbriated ampulla of the fallopian tubes. The fallopian tubes are relatively short and extend from the ovary to the extremity of the horn of the uterus.

The uterus is composed of a short body, the bifurcation of which forms the horns. The body rarely exceeds 2 inches in length. The horns are relatively long and irregularly flexuous. They are loosely suspended by the broad ligaments.

The vagina is about 5 inches in length and is relatively small in caliber. The vulva is 3 to 4 inches in length and presents a superior commissure that is rounded and an inferior pointed commissure.

The clitoris is relatively long. The urethra is from 3 to 4 inches in length.

The mammae are arranged in two series on either side of the median line. There are 10 or 12 distinct glands and the same number of teats. Each teat usually has two openings and two ducts.

The urine of swine is clear, of slight odor, pale color, faint alkaline reaction and has a specific gravity of 1010 to 1015. The composition is approximately as follows:

Urea	5%
Potassium bicarbonate	10%
Potassium sulphate	2%
Magnesium carbonate	1%
Sodium chloride	1%
Phosphates	1%
Water	80%

Fig. 34. External and internal generative organs of the sow. A, ovaries; B, uterine horns and fallopian tubes; C, uterus; D, vagina; E, vulva. (White's Castration.)

The exact composition of the urine of swine depends upon the nature of the food. The amount excreted daily varies from 8 to 15 pints.

Mammary Secretion

The mammary glands of the sow are arranged serially on either side of the median line and usually consist of 10 to 12 distinct glands. An ordinary sow produces from 4 to 7 lbs. of milk per day. The composition of the milk according to the average of a series of analyses is as follows:

Butterfat	7%
Casein and albumin	6%
Sugar	5.7%
Ash	1%
Water	80.3%

From the above it will be seen that the total solids of sow's milk are relatively high. The fat globules of sow's milk are only about one-fourth the size of those of cow's milk, which renders sow's milk more readily digestible. By a limited number of experiments, it has been found that by increasing the albuminous constituents in food there will be an increased production of milk and also an increased percentage of fat in the milk. The mammary secretion usually continues for from ten to fifteen weeks.

Swine are prone to various disease conditions of the organs constituting the uro-genital system. This may be due to the nature of their feed stuff, which is often fermented or putrid.

Kidneys

Kidney diseases are especially common in swine. Frequently the pathologic condition of the kidneys is not of sufficient intensity to

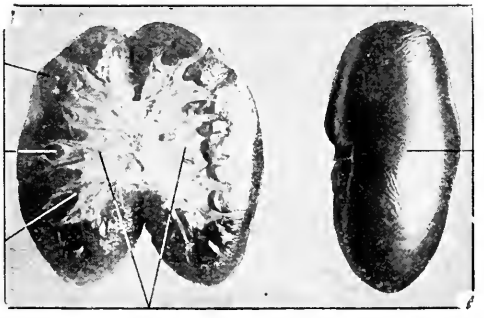

Fig. 35. Kidney of swine. Surface and section. (Ostertag.)

produce recognizable symptoms, but a diseased condition is easily detected by autopsy or on inspection of the carcasses of dressed hogs.

MALFORMATIONS

There may be a total absence of one or the other kidney. A horseshoe-shaped kidney is also occasionally observed. Floating kidney has been reported, but from the number of recorded cases the condition is relatively rare.

HYDRONEPHROSIS

Hydronephrosis, or cystic kidney, is of frequent occurrence in swine. It is very commonly encountered by the food inspector.

Tucks reported 0.67 per cent of cystic kidneys in over six thousand hogs examined, and the writer found this condition in the kidneys of twenty-nine swine in three thousand examined. The condition may affect one or both kidneys.

Etiology.—Obstructed outflow of urine is the primary cause of cyst formation in the kidney. The anatomical arrangement of the openings of the ureters into the bladder predisposes to their obstruction and therefore to the accumulation of urine in the kidney pelvis. Renal and pelvic calculi and inflammatory products occasion obstruction of collecting tubules and favor cyst formation. Cicatrization of newly formed fibrous tissue may obstruct the outflow of urine and cause cyst formation. Complete obstruction of the ureters or kidney pelvis will not as a rule result in hydronephrosis, as this condition results in a compensatory activity on the part of the normal kidney.

Lesions.—Hydronephrosis may occur as cysts in the renal substance or the kidney may be practically replaced by a variable-sized watery bag. The cysts vary in size from a pinhead to an inch in diameter. There may be myriads of the small cysts scattered throughout the kidney but occurring primarily in the cortical portion. The larger cysts are usually not numerous and they frequently represent the fusion of small cysts. The cysts have a bluish-white color, are definitely surrounded by a distinct capsule, and the content is thin and watery. The kidney substance between the cysts is atrophied, due to pressure. In extreme cases the kidney capsule may serve as the cystic capsule, the entire mass being much enlarged and the small atrophied kidney floating within. Richter reported a case of a hydronephrotic kidney weighing over ninety pounds.

HEMORRHAGE

Kidney hemorrhage is relatively common in swine, not as a primary condition, but associated with some disease. The extravasated blood may escape into the uriniferous or collecting tubules, producing hematuria, or it may escape into the kidney tissue.

Etiology.—Injury of the capillaries, either glomerular or tubular, may result in hemorrhage. The vessels are most frequently damaged by chemical substances that are being eliminated in the urine or by products of bacteria produced in the kidney or elsewhere in the body.

Lesions.—Escaped blood into the uriniferous tubules may be detected by examination of the urine, which, by the way, is very infrequently done. The urine will be discolored with hemaglobin and will contain blood casts. Renal-tissue hemorrhages may be extensive or limited, but rarely is extensive extravasation observed in the kidney. Small-tissue hemorrhages, particularly petechial hemorrhages, are of common occurrence in the kidney of swine affected

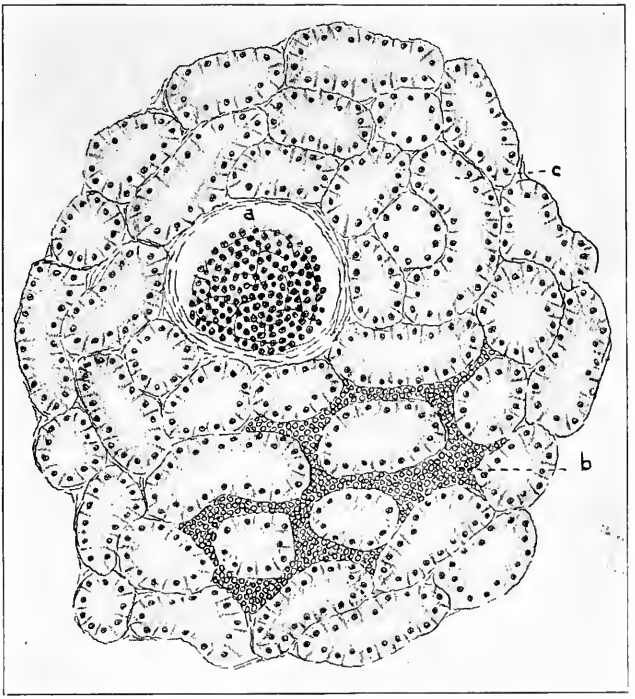

Fig. 36. HEMORRHAGIC KIDNEY—HOG CHOLERA. A, glomerule; B, normal kidney tissue; C, hemorrhagic petechia.

with hog cholera. Such hemorrhages have been observed in the kidney of otherwise apparently healthy swine in which no other lesions of cholera could be detected, and the blood from these hogs, when injected into healthy, susceptible pigs, failed to produce evidence of hog cholera. These hemorrhages were not numerous; sometimes only a few could be recognized by a careful examination; their exact relation has not been discovered. The petechial hemorrhage of cholera merely evidences a vascular disturbance.

Symptoms.—The symptoms of renal hemorrhage except in those cases in which the blood escapes into the renal tubules and produces hematuria are obscure. In rare instances hemorrhage into the kidney tissue may be so extensive that the elimination of urea is diminished to an extent that the animal will evidence symptoms of uremia. The usual symptoms of infectious diseases in which renal hemorrhage occurs are readily recognized but are not dependent upon the hemorrhage into the kidney.

Treatment.—The treatment of renal hemorrhage is not satisfactory.

FATTY CHANGES

The occurrence of the so-called large white kidney is a common experience, at least to those engaged in meat inspection. "Large white kidney" is a name applied to two different conditions—fatty kidney and fibrous kidney. The fatty white kidney is less common than the fibrous white kidney.

Etiology.—Some renal vascular disturbance in the kidney or general malnutrition appears to be the causative factor in the production of fatty kidneys.

Lesions.—The affected kidney is large and creamy white in color. The capsule is easily stripped, and the kidney substance is soft and feels greasy. Only one kidney is affected in those cases in which the kidney is exceedingly large. Both kidneys may be affected, but only to a limited degree.

Symptoms.—No primary symptoms characterize this condition. It is detected only on autopsy.

CALCULI

Renal calculi occur but are not common in swine. They may occur in the collecting tubules but are more likely to be found in the renal pelvis.

Etiology.—The formation of renal calculi is usually associated with an obstructed outflow of urine. Retained urine in the renal pelvis or in the collecting tubules has a tendency to undergo fermentation, with the production of an unbalanced condition of the chemical constituents resulting in precipitation. Retained urine and fermentation also favor catarrhal inflammation. The mucopurulent discharge may serve as a nucleus upon which the precipitate is deposited.

Lesions.—Retention of urine and catarrhal inflammation are usually evident. The calcular deposits may be very small and difficult to detect or they may be quite large, one having been observed that practically filled the renal pelvis. The calculi may be variable in shape, color, and consistency, depending upon their composition, and are composed of magnesium or calcium phosphates, urates, or carbonates.

Symptoms.—Cloudy urine, particularly when the last discharge contains quantities of brownish deposit, will be observed if the calculi are passing out. The animals will have colicky pains, the loins will be sensitive, and the animals will stand with arched back. If the calculi are small and remain in the kidney there may be no evident symptoms.

Treatment.—If the patient is in good condition it will be most economical to sell it for slaughter. Very little can be done toward the actual solution of the formed calculi.

CONGESTION

Congestion of the kidneys is common in swine fed on putrid or fermented foods. It may occur as a result of undue exposure, to cold experienced in shipping, or it may be due to injury. The condition is associated with erysipelas, hog cholera, and some forms of pneumonia.

Etiology.—Chemical poison obtained in food, by-products of infection, or destructive metabolism cause renal congestion. Exposure and injury may also produce this condition.

Symptoms.—Stiffness and a stilty gait due to hypersensitiveness of the loins usually accompany congestion. There is also frequent urination in which an excessive quantity of urine is voided.

Treatment.—Remove the cause, give good food, and provide sanitary surroundings. Alkaline diuretics may be of value, and laxatives may also be used to advantage.

NEPHRITIS

It is not possible with the present available knowledge to classify the inflammatory disturbances of the kidney in a satisfactory manner. The principal knowledge of porcine nephritis has been obtained from investigation by veterinarians in food-inspection service. The condition is rarely recognized clinically, or at least

the reports of clinical cases of nephritis in swine are very rare. Urinalysis is not practiced systematically by veterinarians, and the analysis of swine urine by practitioners is practically an unheard-of procedure. According to the findings of the veterinary inspectors, porcine nephritis is very common. In some instances nephritis appears to be the only pathologic condition existing, but it is also an

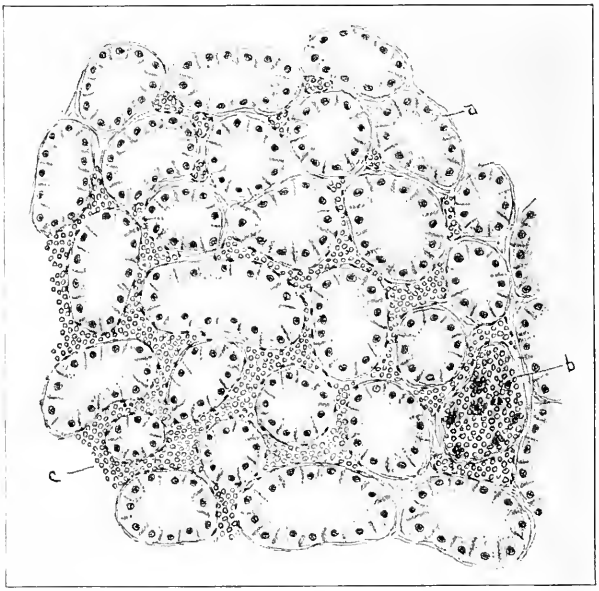

Fig. 37. HYPEREMIC KIDNEY. A, convoluted tubule; B, glomerules engorged with blood; C, engorged capillaries between tubules.

accompanying pathologic factor in such diseases as hog cholera, swine plague, septicemia, and pneumonia.

Acute Parenchymatous Nephritis

This is an inflammation of the cells of the glomeruli and convoluted tubules and is characterized by a rather rapid onset, tumefaction, and frequently destruction of the affected epithelium.

Etiology.—Exposure to cold and injuries of various kinds predispose to this disease. The specific exciting causes are usually chemical substances that are being eliminated through the renal epithelium. Bacterial products, and vegetable and mineral poisons, when present in sufficient quantities, are capable of establishing in-

flammation. Thus pneumonia, hog cholera, swine plague, and septic infections are usually accompanied by nephritis. Some serum producers have had losses of hyperimmune swine due to contaminated virus. In the swine that died in these cases not only the lesions evidencing general septic infection were present but also marked lesions of an acute parenchymatous nephritis. Turpentine, phenol, and the various coal-tar products are capable of producing nephritis. Cor-

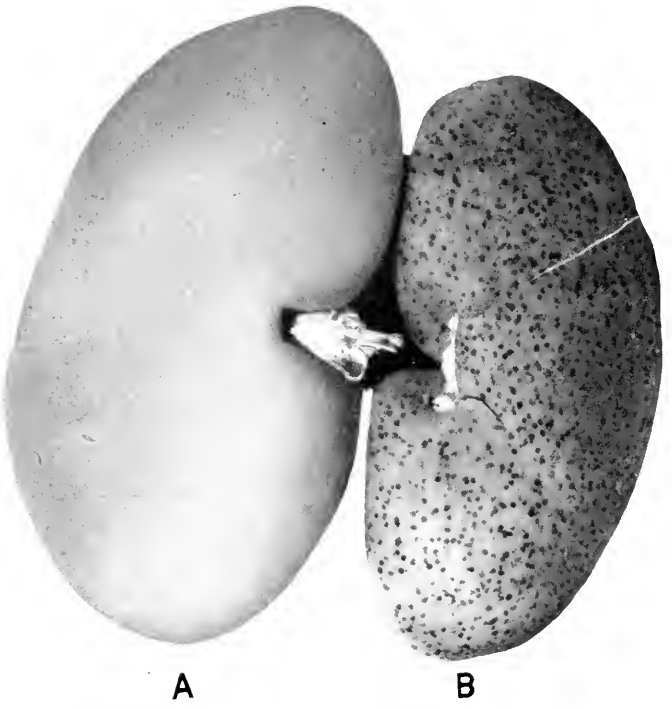

Fig. 38. KIDNEYS. A, normal; B, hog cholera (turkey egg) kidney.

rosive sublimate, too, may be obtained in sufficient quantities to produce the disease.

Lesions.—The lesions of acute parenchymatous nephritis are practically confined to the epithelium of the glomeruli and convoluted uriniferous tubules. The affected kidney is slightly enlarged and has a parboiled appearance. The capsule is easily removed, the kidney substance is usually soft, and blood escapes freely from a cut surface. Microscopically the affected epithelium is affected with hy-

peremia and cloudy swelling which may become so intensive that the cells undergo necrosis. The detritis of the dead cells and coagulated exudate, accumulated in the lumina of the tubules, may be readily observed. The intertubular tissue may be infiltrated with leukocytes. If the inflammation is intense there may be hemorrhage into the kidney substance or into the glomeruli or tubules.

Symptoms.—The animals show evidence of distress. One of the first indications of the disease is arched back and stilty gait. There are frequent attempts at urination, but little urine is voided, and the animals usually have a temperature ranging from 104 to 106 degrees Fahrenheit. In the beginning of the attack they may eat, but inappetence becomes evident soon after the onset. It is possible that the foregoing symptoms are not characteristic of uncomplicated nephritis, but of cases in which nephritis was the most prominent condition. In the cases that have been observed the disease most frequently terminated fatally in from two to four days after the on set, the few cases that recovered requiring from one to six weeks.

Treatment.—The treatment of nephritis in swine is a difficult problem. Resort should be had to the usual hygienic practices. Diaphoresis is not practical in swine, and purgation should not be resorted to as a means of elimination, for such procedure would probably aggravate the condition existing in the kidney. General treatment of symptoms as they arise is probably all that can be accomplished therapeutically until further knowledge is obtained.

Acute Interstitial Nephritis

An occasional kidney is found in which there is a leukocytic invasion and other evidence of a reaction in the interstitial or supporting tissue, the parenchymatous tissue being unaffected. But this condition is not common, and thus far has not been observed clinically in swine.

Purulent Nephritis

Purulent nephritis is inflammation of the kidney characterized by the formation of pus, a condition of frequent occurrence in swine. In the study of swine kidneys from abattoirs one-half of one per cent have been found affected.

Etiology.—Pyogenic cocci and the colon bacteria are the most common causative agents. Purulent inflammation elsewhere in the body predisposes to renal metastasis, although purulent inflammation may

occur primarily in the kidney. Constipation is probably a predisposing factor of colon-bacillus invasion of the kidney.

Lesions.—Suppuration may be circumscribed, thus forming an abscess or multiple abscess, or it may be diffuse. Metastatic purulent nephritis usually involves both kidneys, and small suppurative centers occur as gray or yellow areas which are surrounded by a hyperemic zone. The larger foci may be quite definitely circumscribed and frequently have small bands of fibrous tissue extending from the capsule into the purulent center. Microscopically the small centers are found in the beginning to be collections of leukocytes and later of pus. The surrounding parenchymatous tissue will be affected with cloudy swelling, as in acute parenchymatous nephritis.

Symptoms.—Practically the same symptoms are observed in purulent nephritis as in acute parenchymatous nephritis, except that in those cases in which there is absorption of quantitis of pus, there is evidence of pyemia.

Treatment.—Symptomatic treatment may be of value. The cause should be removed, and the patient given sparingly of easily digested food.

Chronic Nephritis

Chronic nephritis is a common condition in swine. It is not an important disease from the viewpoint of the practitioner, but it is of some economic importance to the packer as many kidneys are found to be affected. Chronic nephritis represents a group of pathologic conditions—at least, there is a variety of different types of lesions observed. One type of chronic nephritis has been studied and named "chronic non-indurative nephritis," but from the general lesions in these kidneys it seems probable that the condition is confined to the parenchyma and should be called "chronic parenchymatous nephritis."

Chronic Interstitial Nephritis

Typical chronic interstitial nephritis is characterized by the proliferation of fibrous tissue which may or may not cicatrize. This condition includes white-spotted kidneys, some large white kidneys, granular kidneys, sclerotic atrophied kidneys, and all variations of the foregoing.

Etiology.—Chronic nephritis, especially the type involving only the

supporting framework, is caused primarily by relatively mild irritants acting over a long period of time. These cases have not been recognized clinically, but by tracing the swine that show the lesions when slaughtered it is usually found that the feed of the animals has been at fault. In some cases parasites and calculi are responsible for the condition.

Lesions.—Chronic parenchymatous nephritic kidneys are enlarged. The capsule is not easily removed, and when pealed off small fragments of kidney tissue remain attached to it. The kidney is mottled, due to hemorrhages and infarction, and there is no definite line of demarcation between the medulla and cortex. Microscopically the parenchymatous cells are found enlarged and cloudy, but tube casts are rarely observed.

Chronic interstitial nephritis is characterized by fibrous proliferation. The newly formed fibrous tissue may or may not cicatrize. The gross appearance of the kidney varies according to the amount and disposition of fibrous tissue. If the condition is localized according to the distribution of small arteries the fibrous tissue will occur in foci, and spotted kidney is the result, the white spot being masses of fibrous tissue. If this fibrous tissue is uniformly deposited throughout the kidney and does not cicatrize, the kidney is enlarged, dense, and hard—one of the types of the large white kidney. Granular kidneys are the result of the proliferation, and later cicatrization, of fibrous tissue in and around the glomeruli or tubules. Granular kidneys have rough, small projections thickly studded over the surface; such kidneys are usually of a red color. The extensive proliferation and cicatrization of fibrous tissue in all the cortical substance, when associated with a thickening of the capsule, produce the small, hard, or sclerotic kidney. Microscopically excessive quantities of fibrous tissue are found, and the parenchymatous tissue is diminished, due to pressure atrophy. Sometimes there may be large areas of fibrous tissue in which no parenchymatous tissue appears or only remnants of tubules or glomeruli.

Symptoms.—Records of the clinical evidence of chronic interstitial nephritis in swine are wanting. Swine with extensive kidney lesions are usually in fair condition when they are observed at the time of slaughter.

Treatment.—The application of therapeutic agents for the relief of chronic interstitial nephritis in swine has not been practiced. Should

such a case be diagnosed, the removal of the cause and the provision of good quarters and wholesome food would probably be sufficient until the animal was in condition for slaughter.

PYELONEPHRITIS

Pyelonephritis is an inflammation of the pelvis of the kidney, a condition that has been observed in swine but is rare.

Etiology.—Calculi and parasites are frequently predisposing factors in this disease. Primarily, the disease is the result of infection. Pyogenic bacteria may cause the condition, but more frequently it is caused by a pleomorphic organism that has been named *corynebacillus renalis.*

Lesions.—The pelvis of the kidney is dilated with a thick, brownish, purulent fluid and tissue shreds. The mucosa of the renal pelvis is thick and contains hemorrhagic spots. The kidney may contain purulent centers or it may be converted into a purulent mass.

Symptoms.—Frequent urination is a symptom of this disease, the urine voided being cloudy. Loin sensitiveness and inappetence are also observed in these cases.

Treatment.—Thus far no treatment has been found that is of any value.

ALBUMINURIA

Albuminuria is a condition in which there is elimination of albumin in the urine.

Urinalysis is now in its infancy in veterinary medicine. Considerable time and energy have been devoted to the study of urine from some animals, particularly the horse, but little attention has been given to systematic urinalysis of swine.

Urine has been collected from the bladder of the carcasses of swine that have been slaughtered, and analyzed. It is possible that there may be some modification of the urine of slaughtered animals, but it is doubtful if the changes are of much significance.

Albuminuria has been found to exist in swine showing a high temperature, particularly cases that have been affected with cholera. The urine has also been found to contain varying quantities of albumin in which there was an acute nephritis. Pneumonic cases also evidenced albumin in the urine.

The exact cause of albuminuria is still being debated. The condition in swine, as well as in other animals, occurs in those cases

where the renal epithelium is damaged either by degeneration or inflammation, although it may occur in the absence of damaged epithelium. Some veterinarians are maintaining that albuminuria is caused by acid intoxication.

At this time, with our present knowledge, albuminuria, at least in swine, must be thought of as secondary to some other conditions. Albuminuria in swine has not been studied clinically, therefore, symptoms of the condition cannot be recorded. It is an important condition because albuminous substances that should be conserved are eliminated from the body in the urine. Disturbances of nutrition follow, and the primary and associated conditions produce emaciation and marasmus. Albuminuria usually terminates fatally.

UREMIA

Uremia is a condition characterized by the presence in the blood of a greater or less amount of the solid constituents of urine. This condition has not been identified clinically in swine, but the nature of the lesions observed in some kidneys by veterinary inspectors is sufficient evidence that the disease exists in swine.

Etiology.—The primary cause of uremia is obstructed outflow of urine, which may be the result of disturbance in the kidneys, ureter bladder, or urethra. Severing or puncturing the ureters during operations, as in cesarean section, may result in uremia.

Lesions.—No particular gross tissue changes are attributed to uremia. The lesions found are those incidental to the obstruction of the outflow of urine, as calculi, tumors, and so on.

Symptoms.—Stupor, vertigo, emesis, inappetence, diarrhea, clonic muscular spasms, and convulsions are the principal symptoms of uremia. The disease, at least in the acute form, is usually fatal. Chronic uremia is associated with digestive derangements.

Treatment.—Removal of the cause is practically always successful unless the case is too far advanced. Therapeutic treatment is of no value.

HEMATURIA

Hematuria is a condition in which there is blood in the urine and is relatively common in swine. Blood may contaminate urine in the kidney, ureter, bladder or urethra.

Etiology.—Injuries of blood-vessels, particularly of capillaries, is

one of the most common causes of hematuria. Capillary injuries may be caused by chemic irritants that are being eliminated by the kidney, or by microbes or other products. Thus, hematuria of renal origin is common in acute inflammatory disturbances of the kidneys, and is a frequent symptom in certain acute infectious diseases, such as anthrax, hog cholera and swine plague. Calcular formations in any portion of the urinary passage are prone to produce hemorrhage. Tumors such as papilloma and angioma may be so located in the urinary passages that erosion of blood-vessels may occur and permit of the escape of blood.

Lesions.—Hematuria is characterized by blood in the urine. The kidney lesions in those cases in which there is blood in the urine will depend upon the cause of the hematuria and there may be evidence of any of the various types of nephritis; anatomical alterations characterizing anthrax, hog cholera or swine plague; tumors in the renal pelvis or the parenchyma of the kidney; and renal calcular formation. The lesions of the ureter, bladder and urethra may be inflammatory in character, alterations due to tumor formation or the result of calculi.

Symptoms.—The pathognomonic symptom of hematuria is blood in the urine. The origin of the blood may be determined by urinalysis coupled with a careful examination of the case. Renal hematuria, excepting in those cases in which the blood has entered the urine in the pelvis of the kidney, is typified by blood tube casts. Hemorrhage into the urine in the renal pelvis, ureters, or bladder is characterized by a relatively complete admixture of the blood and urine. In urethral hemorrhage the blood precedes the urine during urination.

Treatment.—The treatment of cases in which hematuria is present will depend upon the cause of the condition. If hematuria is the result of chemic irritants being eliminated from the kidney, soothing diuretics are indicated, such as buchu or corn silk. In cases where hematuria is associated with infective diseases, the usual methods employed in combatting the infection should be used. The treatment of cases of hematuria resulting from tumors or calculi is not satisfactory. Hematuria of cystic origin may be overcome in females by catheterization and the introduction of antiseptics and astringents into the bladder. Urethral calculi in males may be removed by operation and the condition causing hemorrhage removed.

PARASITES

The cystic form of the Tænia solium of man has been observed in the kidney of swine, but is not of common occurrence in that location. The cystic forms of the Tænia echinococcus also occur in this organ.

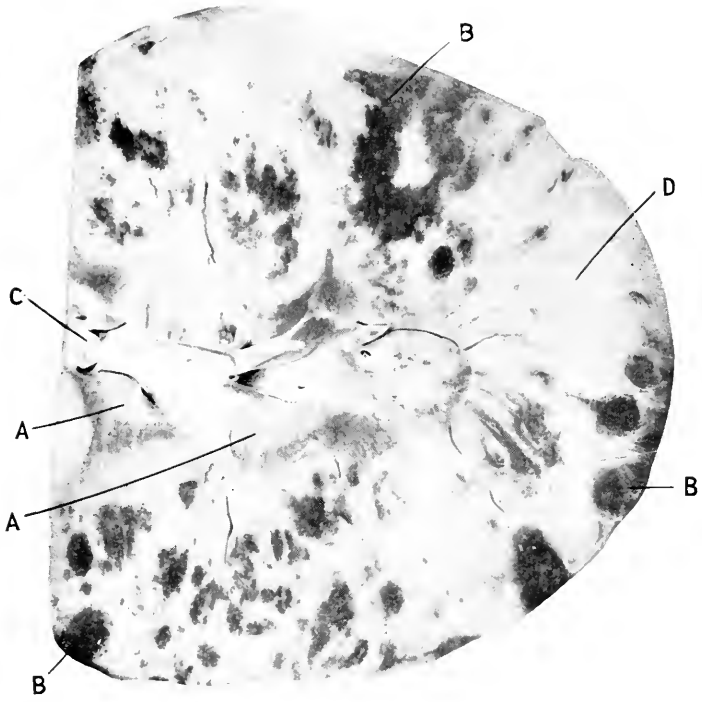

Fig. 39. Adeno-sarcoma of the kidney.—A, Normal kidney tissue; B, hemorrhagic areas; C, pelvis; D, sarcomatous tissue. This kidney was seven or eight times the size of a normal kidney.

The Stephanurus dentatum is sometimes found in the kidney structure, although it more commonly occurs in the perirenal fat.

TUMORS

The kidney of swine is affected with adenosarcoma. In the living swine the presence of these tumors is not suspected. They appear

as irregular, incapsulated masses, usually involving only one kidney, and in size vary from five to fifteen pounds. Although they have not been recognized clinically, their structure and appearance evidence rapid growth. They have their origin in the kidney substance near the pelvis, and the tumor tissue produces pressure atrophy of the renal parenchyma. The outline of the tumor is irregular and frequently lobulated. On being sectioned, fibrous bands are found extending in various directions and dividing the tumor mass into lobes. The neoplastic tissue is of a white or dirty-white color, but is often mottled, due to hemorrhage; there may also be grayish-yellow centers of necrosis. Microscopically these tumors are composed of embryonic epithelium and connective tissue, the epithelium disposed as irregular tubules or remnants of tubules, while the connective tissue occurs around and between the epithelial tumor cells. Sometimes larger areas of embryonic connective tissue cells are found independent of epithelium, and again the epithelium may occur in nests in the sarcomatous tissue.

The time for growth of these tumors has not been determined, but they are most frequently found in swine less than two years of age.

Sarcomas have also been encountered by veterinary inspectors in the kidney of swine. They are usually metastatic, although one case of a primary, large-spindle celled sarcoma has been recorded.

Ureters

MALFORMATIONS

Malformations of the ureters are not uncommon, but the malformations that are observed are not of such a nature that the function of the organs is interfered with and therefore are of no practical importance.

Renal pelvic calculi may become lodged in the ureters and establish inflammatory disturbances, and also obstruct the lumen.

The ureters are subject to injuries in spaying and other abdominal operations.

Bladder

MALFORMATIONS

Malformations of the bladder are not common. A few cases of double bladder have been recorded, or the bladder may be very small,

such animals urinating frequently. Vestiges of the urachus may be retained, and these may become cystic.

HEMORRHAGE

Hemorrhages into the bladder sometimes occur in swine. They are caused by injuries which may be inflicted by calculi and from disease of the mucosa. They may also be caused by drugs, such as cantharides and turpentine, obtained accidentally in large quantities. This condition is frequently associated with such diseases as hog cholera.

Lesions.—The primary lesions observed depend upon the cause of hematuria. There may be cystic calculi, injuries of various kinds, infection, and lesions elsewhere in the body. The extravasated blood will be accumulated in the bladder and may or may not be coagulated, and the entire bladder content will be colored red with hemaglobin liberated from the disintegrated red blood cells.

Symptoms.—Hematuria is evidenced by bloody urine in which the entire urine is uniformly red. It is distinguished from renal hemorrhage by the absence of tube casts, and from urethral hemorrhage by the fact that in urethral hemorrhage only the first urine voided is red.

Treatment.—The exact cause should be identified and removed. Urinary sedatives may also be of value.

DILATATION

Cystic dilatation is sometimes occasioned by urethral obstruction or spasms of the muscles in the neck of the bladder. The urine continues to be produced in the kidney and accumulates in the bladder until its capacity may be far in excess of the normal.

Lesions.—The characteristic lesion of dilatation consists of distention of the bladder and attenuation of its walls. In fatal cases the bladder ruptures and urine and uriniferous odor are detected when the abdomen is opened, and the rent in the bladder wall will also be evident.

Symptoms.—Distress, anuria, frequent attempts at urination, and possibly some enlargement of the abdomen characterize distended bladder. In distention succeeded by rupture the foregoing symptoms would be succeeded by stupor, vertigo, emesis, inappetence, diarrhea, clonic muscular spasms, convulsions, and death.

Treatment.—Treatment is available only during distention, and effort should be directed principally to removing the cause. If it is a urethral obstruction in the male and the obstruction is below the ischiatic arch an artificial opening may be made into the urethra where it passes over the ischiatic arch, giving temporary relief, and if the obstruction cannot then be removed the temporary opening in the urethra may be made permanent. In valuable animals obstructive calculi may be removed from the bladder by surgical procedure and the condition thus corrected. Tumors and abscesses that effect urethral obstruction may be removed and permit of the ready outflow of urine through the urethra.

CALCULI

Cystic calculi are of common occurrence in swine. There may be a single calculus or there may be myriads of them. In size they vary from mere grains of sand to masses as large as English walnuts. In shape they may be spherical, ovoid, or various kinds of irregular surfaces and outlines may be presented. Some have been observed that were practically the shape of jack straws. When several occur together they may be faceted. As a rule they are of a dirty-white color, though they may be of any color. They are usually composed of magnesium and calcium phosphates and carbonates.

Etiology.—Retention and fermentation of urine in the bladder favor calculous formation. Retention and urine fermentation also favor catarrhal inflammation, which is associated with epithelial desquamation, and this serves as a nucleus for the calcareous deposits.

Lesions.—The presence of calculi is the principal thing to be sought for, and they are not difficult to identify. There is also more or less evidence of catarrhal cystitis, and there may be retention of urine.

Symptoms.—Evidence of catarrhal cystitis—that is, frequent voiding of relatively small quantities of urine—characterizes most cases of cystic calculi. The urine in these cases is frequently acrid and may produce disturbances in and around the prepuce of the male and in the perineal region of the female. Should the calculi produce obstruction to the outflow of urine there will be symptoms of cystic distention.

Treatment.—Solvents for cystic calculi are not wholly successful.

If the calculi are causing such disturbance that marked symptoms are evident, operative procedure is indicated, providing the value of the animal is sufficient to justify it.

CYSTITIS

Inflammation of the bladder may be catarrhal or purulent. Neither type has been extensively investigated by the clinician, therefore the present knowledge concerning them has been obtained by veterinarians at abattoirs.

Catarrhal Cystitis

Catarrhal cystitis is not uncommon. In many instances the condition is associated with cystic calculi, but it may also be caused by infection. Occasionally several cases of catarrhal cystitis may occur simultaneously or successively in the same herd, and on obtaining the history it is found that the affected swine have been fed food stuff containing some urinary irritant or they have obtained quantities of turpentine or cantharides. Retention and fermentation of the urine predispose to inflammation of the cystic mucosa because of the liberation of ammonia.

Lesions.—Catarrhal cystitis is characterized by the following sequential lesions of the mucosa: hyperemia, tumefaction, and coating of the surface with tenacious mucus, desquamated epithelia, and pus cells. Later there is desquamation of the surface epithelium, leaving a denuded granulating surface.

Symptoms.—Frequent attempts at urination in which small quantities of a turbid urine are eliminated are symptoms of catarrhal cystitis. There may be a straddling gait.

Treatment.—Remove the cause. The bladder in females may be cleansed by a weak solution of corrosive sublimate or creolin, and urinary sedatives should be administered. Internal treatment is practically all that can be given in male animals affected with cystitis.

Purulent Cystitis

Purulent cystitis is an inflammation of the urinary bladder accompanied by the formation of pus. This condition is not so common in swine as catarrhal cystitis. Predisposing causes mentioned in catarrhal cystitis are also operative in purulent cystitis. The exciting cause is most frequently the Bacillus coli communis, al-

though any of the pyogenic cocci may produce it, even the Bacillus pyocyaneus being responsible for an occasional case of cystitis.

Lesions.—Hyperemia, tumefaction of the mucosa, accumulation of tenacious mucus upon the mucosa, and the production of pus in quantities characterize purulent cystitis. The surface mucosa is eroded and becomes a granulating surface.

Symptoms.—Frequent urination and the voiding of small quantities of urine admixed with pus typify purulent cystitis.

Treatment.—Remove the cause, and cleanse the bladder of females with weak antiseptics. The males should be treated by internal medication, with urinary antiseptics and sedatives.

TUMORS

Very few tumors have been observed in the bladder of swine. Papillomata have been reported in a few cases.

Urethra

MALFORMATIONS AND INJURIES

The urethra may be imperforate, particularly in the male. Such cases are rarely observed, and those affected die soon after birth. The condition is easily remedied providing the imperforation is near the outlet, by making a crucial incision or by puncture with a small trocar.

Injury of the urethra in males may be inflicted by contact with barbed wire or other sharp objects, and the female urethra may be injured by forceps used during parturition. These injuries are not serious, though occasionally they may result in permanent fistulas.

STRICTURE

Stricture of the urethra may follow injuries or inflammation. In male swine catheterization is not practicable, and it is not an easy matter to locate a stricture or other obstruction in their urethræ.

URETHRITIS

Urethritis occurs in swine. It is most frequently a sequel of cystitis, although it may occur as a primary condition. It is probably more common in males than in females, and is evidenced by painful urination. Treatment consists in giving urinary sedatives and inducing the animals to drink large quantities of clean, wholesome water in order that the urine may be diluted.

Prostate Gland

The prostate gland is located beneath the vesiculæ seminales and embraces the neck of the bladder. This gland is not well developed except in boars. It is occasionally enlarged, due to infection with tubercle bacilli, colon bacilli, or pyogenic cocci. There may be abscess formation or fibrous proliferation in the prostate. Enlarged prostates partially obstruct the urethra by pressure, thus making urination difficult.

Bulbo-Urethral or Cowper's Glands

These are large glandular structures located on either side of the posterior portion of the pelvic urethra. They are less developed

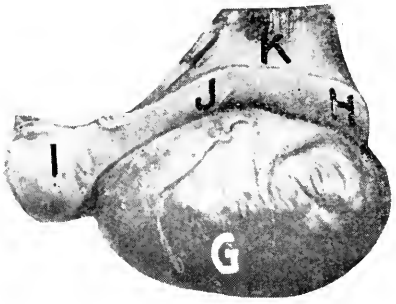

Fig. 40. Testicle of ridgling boar. G, testes; H, globus major; I, globus minor; J, body of epididymis; K, spermatic cord. (White's Castration.)

in the castrated animal, particularly if the operation be done in early life. They are also subject to infection and enlargement which produces pressure obstruction upon the urethra.

Testicles

Malformations of the male sexual glands are not uncommon, one or both testicles sometimes being abnormally small. Cryptorchidy is of common occurrence in swine. De Wolf inspected 4,671 male swine and found twenty-eight single, and seven double cryptorchids. Nearly five per cent of the male progeny of one of Missouri's most famous boars, Chief Tecumseh II, were cryptorchids. Liberty Chief and Chief I Know, two boars sired by Chief Tecumseh II, were

noted breeders, and from three to five per cent of their get were cryptorchids. Chief Perfection II, sired by Chief Tecumseh II, was the sire of Chief Cherokee Perfection, that in turn sired about three per cent of cryptorchids. Cryptorchidism diminishes the value of a pig because of the greater castration risk.

Because of their location, the testicles of a boar are subject to injuries of various kinds. Some instances have been observed in which it was necessary to castrate valuable boars that had their testicles so lacerated that recovery of their function was not possible. Injuries may be inflicted by dogs, sharp-cutting objects, or by crushing, as a result of cattle or horses treading upon the glands.

ORCHITIS AND EPIDIDYMITIS

Inflammation of the testicle has been observed, but is not of common occurrence in swine. Orchitis and epididymitis are not easily differentiated. They are most frequently the result of mechanical injury, although they may result from infection. Tuberculous orchitis is not common in swine.

Lesions.—The affected testicles or epididymi are enlarged and hyperemic. The secreting structures have a parboiled appearance. Suppurative orchitis is characterized by the formation of abscesses, or it may assume a diffuse form of suppuration in which pus infiltrates the tubular and intertubular tissue.

Microscopically, the arterioles and capillaries are gorged with blood, and there is exudation into the seminiferous tubules and intertubular spaces of leukocytes and plasma. The spermatogenic cells are cloudy and may show disintegration. The spermatozoa are more or less disintegrated and inactive.

Symptoms.—Enlarged, sensitive testicles are the chief symptoms by means of which orchitis or epididymitis is identified. There may be abnormal sexual excitement.

Treatment.—Unless the animal is very valuable for breeding purposes, castration should be resorted to; otherwise, remove the cause and apply hot compresses, or alternating hot and cold compresses, upon the affected glands. Place the patient in comfortable quarters and where there will be no occasion for sexual excitement.

TUMORS

Testicular tumors are not common but appear as frequently in swine as in other animals. Both dermoid and dentigerous cysts

have been encountered in the testicle, and while these are not destructive to life, they damage the animal for breeding purposes. Sarcomas and endotheliomas occasionally occur in the testicle, and are usually primary. They are malignant tumors, however, and swine with enlarged testicles are usually castrated. Fortunately, the operation is commonly performed before the tumors have metastasized, and thus the lives of the swine are not sacrificed.

PARASITES

Screw Worm Infestation

Infestation of the castration wounds with screw-worms (larvæ of the Campsomyia macellaria) are very common in the southern part of the United States. These larvæ burrow into the tissues, thus mechanically injuring them and providing an avenue of entrance for various bacteria.

Lesions.—The principal lesions consist of an active, acute inflammation with or without the production of pus. The surrounding tissues are tumefied, hyperemic, hemorrhagic, and contain the larvæ. The extensive tumefaction developing within one or two days after castration is the most evident symptom. On a close inspection, larvæ may be observed near or upon the surface, and by manipulation of the lesion larvæ may be forced out upon the surface. In cases of screw-worm infestation there is a constant sero-sanguineous discharge that by attracting the female fly favors repeated reinfestation.

Treatment.—All that can be done in cases of screw-worm infestation is to support the strength and minister to the comfort of the animal and prevent a further infestation from the deposition of more eggs or larvæ upon the wound and patiently wait for the investing larvæ to reach the stage of development when they voluntarily leave the wound to pupate in the ground. This occurs in three to five days.

The application of chloroform, naphthalene or other chemicals to the wound is worse than useless. Such measures not only fail to effect the removal of more than a small percentage of the larvæ, but they also irritate the highly sensitive tissues and greatly aggravate the condition.

None of the ordinary fly-repellents has any deterrent effect upon the female of the screw-worm fly in the presence of fresh blood, either in recent wounds or in the discharge from screw-worm infested wounds. However, a mixture composed of turpentine one

dram, phenol one dram and cotton seed oil four ounces is an effective repellent for this fly, and where there is a probability of screw-worm infestation it should be applied to fresh wounds and to infested wounds as long as the screw-worm larvæ are present and the sanguineous discharge continuous. One application daily is sufficient.

Penis

Malformations of the penis are rare. One case has been observed of a double penis, the organ being double from the ischial arch. Each penis contained a normal urethra, the two uniting at the arch and continuing to the bladder as a single urethra.

Injury to the penis of barrows is rare, although incised wounds may sever this organ. The penis of boars may be injured by permitting breeding in quarters containing machinery or other places where injuries of various kinds may be inflicted.

Preputial concrements or calculi sometimes occur in swine. They occasion difficulty in urination or even retention of urine and sometimes the urine accumulates in the sheath in considerable quantities. The accretions are easily detected by an examination and are not difficult to remove.

The lining of the prepuce may be infested with screw-worms, which will occasion considerable swelling and distress to the animal. For the treatment see page 198. Preputial inflammation due to irritation from urine and infection sometimes requires care by cleansing and antiseptics.

Ovary

MALFORMATIONS AND INJURIES

Malformations of the ovary are much more common than is generally suspected. The most frequent anomaly consists of changed position which ordinarily does not appear to interfere with the normal functioning of the organs. There may be two ovaries on one side and one on the other, or there may be two ovaries on each side. Either ovary may be exceptionally large or small, the other being normal in size.

The ovaries may be injured, but this is rather the exception, owing to the thick body wall which serves as a protection.

HEMORRHAGE

Hemorrhage of the ovary may occur at the time of estrum, and is dependent upon the lacerating of a blood vessel when the graäfian follicle ruptures. These hemorrhages are of no practical or economic significance.

OOPHORITIS

This condition has been observed in sows, but principally at abattoirs by veterinary inspectors. It is usually secondary to metritis or salpingitis, though it may be metastatic or even primary.

Lesions.—The affected ovary is enlarged, and, the surface being irregular, nodular projections of varying size occur. In the beginning the ovary is intensely red and cut surfaces bleed freely. The nodules represent enlarged graäfian follicles, which usually contain a gelatinous substance and sometimes blood. Latent suppurative centers may occur and may or may not be definitely circumscribed by a fibrous capsule. The condition may assume a chronic form, the ovarian structure becoming dense and hard due to the proliferation of fibrous tissue.

Symptoms.—The principal evidence of ovarian inflammation is persistent sexual desire, and is manifested by excitement, frequent urination, and the search for a mate.

Treatment.—Anodynes may be used to quiet the animal temporarily, and the blood supply may be diverted by means of a saline purgative or atropine in full physiologic doses. Therapeutic agents are not at all certain in these cases, and if the patient is not especially valuable for breeding purposes, spaying is recommended.

CYSTS

Ovarian cysts are quite common in sows. They probably have their origin from graäfian follicles that have failed to properly mature. One or both ovaries may be affected. The cystic ovary may be uniformly enlarged or it may be lobulated, the size attained being variable. Reyer reported a case in which an ovarian cyst was found weighing seven pounds.

Lesions.—The affected ovary may contain either a single cyst or many cysts. The cyst may be ovoid, spherical, or lobulated. In those cases of multiple cysts the cysts sometimes communicate with each other or are multilocular. The cystic content may be a thin, limpid fluid, jelly-like, glue-like, bloody, or even caseous.

Symptoms.—The symptoms presented by a sow affected with cystic ovaries are variable. There may be indigestion and circulatory disturbances, but the most common symptom is persistence of the estrual period, the affected animals usually failing to conceive.

Treament.—Oöphorectomy is the only apparent relief for cystic ovaries. If only one ovary is affected, the sow may still be used for breeding purposes.

DERMOID AND DENTIGEROUS CYSTS

Dermoid and dentigerous cysts occur in the ovary, but are not of common occurrence in swine.

TUMORS

Endotheliomas and sarcomas have been observed in the ovary of swine, but they are rare. They partake of the same nature as do these tumors occurring elsewhere in the body.

Fallopian Tubes

MALFORMATIONS AND INJURIES

Malformations of the fallopian tubes are not common. Injuries to the tubes may occur during the operation of spaying or cesarean section.

An occasional case of pyosalpinx is observed in the carcasses of swine slaughtered at abattoirs. This condition is uncommon, and apparently of little clinical interest.

Uterus

MALFORMATIONS

Malformations of the uterus are not significant because the majority of swine are fattened for market and are not used for breeding purposes. An occasional anomaly is observed, such as a rudimentary uterus, double uterus, atresia of the cervix, and so on.

INJURIES

Injuries to the uterus are not common except in those animals that have had difficulty in parturition and in which instruments have been used. In many instances injuries produce no bad after

effect, but occasionally they provide an avenue of entrance for infection of the peritoneum and may result in fatal peritonitis.

HEMORRHAGE

Uterine hemorrhage in the sow is not of the same gravity as it is in the larger animals; however, its control is more difficult in the sow than in larger animals because of the small size of the uterus.

METRITIS

Metritis has not occurred as commonly in the sow as in the cow until the recent appearance of an apparent infectious abortion which is frequently associated with inflammatory disturbances of the uterus. From the intensity of the process and the accompanying lesions it appears justifiable to pathologically classify porcine metritis as catarrhal, purulent and septic. Catarrhal metritis may be either acute or chronic. In many instances the lesions appear to be confined to the uterine mucosa, and the proper designation would, therefore, be endometritis. Clinically the different types of inflammation of the uterine structures cannot be identified and the dfferent forms of metritis are all considered as differing only in degree or gravity.

Etiology.—Metritis is due to infection and is usually a sequel of abortion or difficult parturition, although an occasional case is observed in which parturition has been apparently normal. There is apparently no one specific microbian agent that is responsible for metritis. Pyogenic micrococci, B. abortus Bang, and various representatives of the colon typhoid group are the principal microorganisms that have been isolated from cases of metritis, although B. pyocyaneus, B. suipestifer, B. suisepticus and some other microbian agents have been found in these cases. Whether any of the foregoing bacteria are the primary cause of the condition or whether they are secondary invaders remains to be demonstrated. It seems probable that the causative factor of abortion in sows will also be found to be the primary cause of metritis.

Lesions.—The uterine horns will be relaxed and dilated, owing to paralysis or failure of contraction after expulsion of the fetuses. The uterine cavity will contain variable quantities of a fluid, the character of which will depend upon the type of inflammation. There are usually fragments or large portions of the placenta within the cavity of the uterine horns or such may be found adhering to the

uterine mucosa. The external genitals are congested and tumefied.

Catarrhal metritis is characterized by congestion and limited tumefaction of the uterine mucosa. The uterine cavity will contain limited quantities of a mucous or muco-purulent exudate. Rarely will fragments of placenta be found in these cases.

Purulent metritis is characterized by intense inflammatory disturbance with the accumulation of pus in the uterine cavity. The uterine walls will be tumefied because of the extensive leucocytic infiltration. The infection and inflammatory process not infrequently extend and involve the contiguous peritoneum, producing a metro-peritonitis. In some cases there will be a general suppurative peritonitis.

Septic metritis is characterized by an intense inflammation of the uterine walls with accompanying necrosis. The uterine cavity will contain quantities of a putrid fluid or semi-fluid. The uterine mucosa may have sloughed, or appear as a macerated yellowish mass. The uterine veins will be engorged, due to thrombic formation. The fallopian tubes and ovaries are frequently involved. The process invariably involves the peritoneum. Metastases and thrombic formation may occur in any part of the body.

Symptoms.—Catarrhal metritis does not produce sufficiently constant symptoms to be readily identified. There is a mucous or muco-purulent vaginal discharge. The affected animal appears unthrifty. There may or may not be a rise of temperature.

Purulent metritis is manifested by a purulent vaginal discharge. The affected animals eat sparingly if at all. There will be a rise of temperature. If the peritoneum is involved the patient will evidence pain when forced to move.

Septic metritis has a rather sudden onset. There will be from 4 to 6° rise of temperature. The animal will have a tucked up appearance. There may or may not be a discharge of bloody fluid from the vagina. The patient will refuse food but drinks freely.

The course of metritis is variable. The catarrhal type may continue for several days or weeks and finally become chronic. The purulent and septic types are invariably acute and the septic type usually terminates fatally. In some cases of purulent metritis the virulence of the infecting microbian agents may be overcome and a quantity of pus will be retained in the uterus, producing pyometra. Many sows that have been affected with metritis become sterile.

Treatment.—The treatment of metritis in sows is not entirely satisfactory, because of the small size of the external genitals which makes it difficult to apply remedial agents. The most successful treatment consists in uterine irrigation, which may in the majority of cases be successfully accomplished by dilating the vagina by means of a speculum and carefully introducing a small tube, such as a horse catheter, into the cervix, then slowly injecting the antiseptic. The injected fluid must be siphoned out, and it is advisable after the irrigation fluid has been withdrawn to inject from one to four ounces of grain alcohol into the uterus. It may be necessary to repeat the irrigation two or three times. Quinine bisulphate in 20-grain doses injected into the axillary space and repeated in twelve to twenty-four hours will be found of value, particularly in cases of septic metritis.

TUMORS

Various tumors, such as fibroma, myxoma, sarcoma, epithelioma, and carcinoma, have been observed in the uterus. The various tumors partake of the same general nature as the same type of tumor elsewhere in the body. Should an antemortem diagnosis be made, and the tumor found to be producing considerable injury, hysterectomy is indicated.

Vagina

Cloaca formation occasionally occurs in swine. This condition results from fusion of the rectum and vagina, there being but one external opening common to the uro-genital and digestive tubes. This deformity does not interfere with health, but it practically prohibits breeding. Although it may be relieved by operation, the value of the animal usually does not warrant such procedure.

Injuries to the vagina are occasionally inflicted during parturition, but the condition is seldom recognized and rarely causes noticeable after-effects.

Inflammation of the vagina usually accompanies metritis. The discharge in such cases is usually purulent and the condition is designated leukorrhea. Vaginal douches relieve simple cases of vaginitis, but if the primary disturbance is within the uterus it must be overcome before the vaginitis will yield to treatment.

Vulva

Although the location of the vulva predisposes it to injury, such mishaps are not common.

Occasionally the Bacillus necrophorus infects the vulvar tissue and produces typical necrobacillosis, which may terminate fatally unless properly treated.

Mammary Glands

Although the mammary glands are modified glands of the skin, they are essential to the life of the newborn. Therefore, a discus-

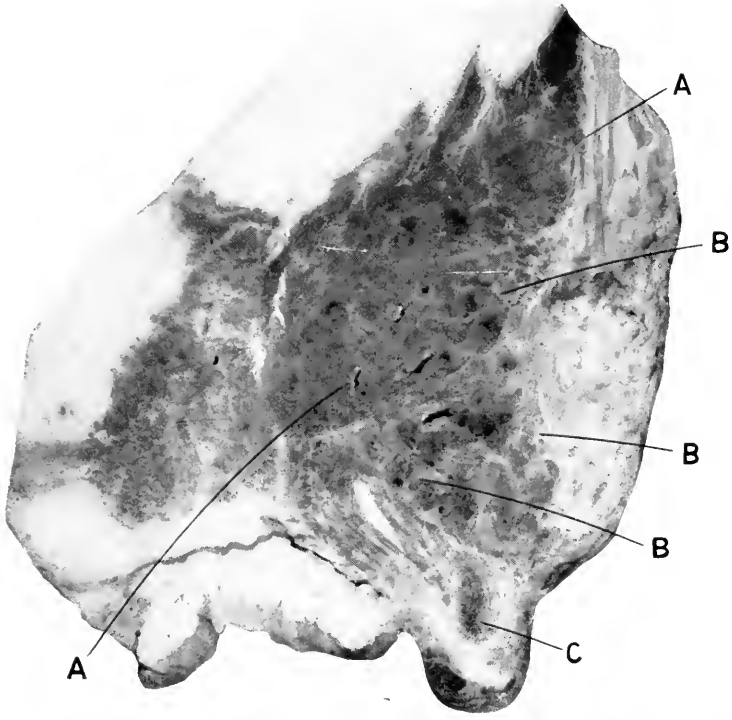

Fig. 41. INFECTION OF MAMMARY GLAND. A, normal glandular tissue; B, calcified areas; C, galactophorous sinus.

sion of the diseases liable to affect these glands belongs properly with the consideration of the reproductive organs.

The location of the mammæ of swine predisposes them to injury and infection of various kinds, and in addition the mammary gland contains a milk cistern which is also easily infected. But since swine

are most resistant to infection than other domestic animals, the mammary disurbances also are less common in swine.

CATARRHAL MAMMITIS

Catarrhal inflammation of the mammæ in sows is relatively common, but fortunately is not severe and is therefore rarely observed as it occasions little inconvenience to the affected sow.

The usual cause of this condition is retention of milk and it occurs primarily at weaning time or in sows that have lost their pigs. The condition is usually overcome if the sow is given a limited ration of laxative foods without any medication. Some practitioners advise the use of phytolacca in the feed in such cases and reports indicate that there may be some value in this treatment.

PARENCHYMATOUS MAMMITIS

Acute inflammation of the mammary gland occurs, but is rare. The usual cause is infection, but this generally means that the gland has been injured and thus predisposed to infection.

The affected gland is tumefied, hot, and painful. On sectioning, varying quantities of milk and inflammatory exudate escape from the ducts. The blood vessels are gorged with blood, and the milk in the larger ducts and cistern contains clots.

The affected sow refuses to allow her pigs to nurse. She will change position as frequently as they attempt it, and occasionally a sow is observed that will purposely injure the pigs if they persist in their endeavor to nurse. On examination, the gland is found enlarged, more sensitive than normally, and if any milk is forced out of the teat it will be more or less ropy.

Treatment.—Hot and cold applications alternated, when possible to apply such treatment, will be of as much value as any local treatment. The administration of a purgative is also advised.

PYOGENES MAMMARY ABSCESSES

Abscesses of the mammæ are quite common in old sows. Botryomycotic, actinomycotic and tubercular abscesses of these glands are described elsewhere as are the disturbances caused by infection with B. necrophorus.

Etiology.—According to the investigations of Ward, the B. pyogenes is the usual cause of these abscesses. It is probable that some previous injury predisposes to this infection.

Lesions.—The abscesses are variable in size and number. In some cases there may be a single abscess, varying in size from that of a pea to that of a hen egg; in other cases there may be a large number of abscesses of variable sizes. One gland may be affected, but in cases of long standing lesions the abscesses are usually found in two or more related glands. The abscesses are usually superficially located. They have a distinct fibrous capsule. The pus varies in color from gray to greenish yellow. In lesions of long standing the pus becomes caseous. In some cases the abscesses appear to fuse forming fistulous tracts.

Symptoms.—These abscesses appear as nodular masses beneath the skin. They are usually dense and resistant. In rare instances the abscess wall may become eroded and pus discharge.

Treatment.—Small superficial abscesses may be dissected out in their entirety without damage to the gland. Large or deep-seated abscesses require destruction of gland tissue and in most cases it is probably advisable to remove the entire gland. The affected animals should be properly restrained and the surgical wounds cared for in the usual manner.

NECROPHOROUS MAMMITIS

This condition is described under the general type of necrobacillosis.

BOTRYOMYCOTIC MAMMITIS

Botryomycotic mammitis occurs in swine, but is not common. The lesions are practically the same as those described for botryomycosis under the heading "Sequels of Castration." Prognosis should always be guarded in those cases in which the mammary gland is removed, as a large percentage of the animals die.

ACTINOMYCOTIC MAMMITIS

Actinomycotic mammitis, in the experience of the writer, is more common in swine than botryomycotic mammitis. Infection occurs through abrasions of the skin surface. This condition is most common in swine that are in pasture in stubble fields. The lesions are the same as lesions of actinomycosis of any soft tissue and consist of a dense surrounding capsule of fibrous tissue inclosing multilocular communicating centers containing a tenacious, granular, creamy-white pus. The actinomycotic tumefaction may become

eroded and the typical actinomycotic pus discharged. Actinomycotic mammitis is characterized by the presence of the tumefaction, which may be round and have a smooth surface or it may be lobulated. These tumefactions vary in size from that of a small marble to masses larger than a baseball.

Ablation of the entire tumor is the most rational and successful manner of combating and relieving this trouble.

TUBERCULOUS MAMMITIS

Tuberculous mammitis is relatively common in swine. The infection of the mammæ may be due to a diseased condition elsewhere in the body or it may be introduced through wounds from the outside.

The lesions are the same as other tuberculous lesions.

Treatment.—If the infection is localized in the mammæ the disease may be successfully treated by operation, but the safest and most sanitary plan is destruction of the animal and cremation of the carcass, thereby diminishing the possibility of spreading the infection.

TUMORS

Mammary tumors are rare in swine, though an occasional papilloma may be observed upon the teat. Rarely do adenomas occur in the mammæ of swine, although a few cases have been reported.

CHAPTER V

ABORTION

Abortion is the premature expulsion of the fetus. Abortion may occur in swine at any time after conception and prior to the time of parturition. If it occurs during the later stages of the period of gestation, the pigs may be alive and, in some instances, may survive.

PREVALENCE

Abortion in sows has prevailed in various sections of this country for many years but fortunately it has not occurred extensively over large sections of the country. During the last few years there have been numerous reports of abortion in swine, and in some localities the condition is becoming so extensive that it is justly causing alarm to the swine breeders.

SUSCEPTIBILITY

Abortion in swine is not confined to any particular breed and from the available information the age of the sow does not appear to be a predisposing factor, as it occurs in first breeding sows or in aged sows.

TYPES OF ABORTION

Abortion in swine may be classed as accidental, non-specific and specific infective abortion. Accidental abortion is due primarily to injuries. This type of abortion in swine is not very common. Non-specific abortion may be due to improper feed, but is more commonly caused by disease in which there is a high temperature, such as hog cholera. Specific infective abortion in swine designates a condition that has been very prevalent recently, in which the disease is apparently transmitted from animal to animal in a herd and assumes the true characteristics of an infective disease.

CAUSE

Certain predisposing factors, no doubt, render swine more subject to abortion. Generally speaking, feed and surroundings are of little consequence as direct factors in the production of abortion except in extreme cases, but improper feed, bad quarters and insanitary sur-

roundings predispose to abortion in swine as well as in other animals.

Non-specific abortions are caused by high temperature, toxins of various infective micro-organisms and perhaps by some other conditions. The specific, causative micro-organism, if there is such, of infectious abortion has not been identified, although a variety of germs have been isolated from the aborted fetuses and uterine discharges. It is possible that a combination of organisms or different organisms will be found to be the general causative factors in the production of this disease. From the information available, it is advisable to consider this type of abortion in swine as infectious.

DISSEMINATION

Reports are available in which it has been demonstrated that an aborting sow may be transferred from an infected herd into a herd free from this disease and establish abortion in that herd. For example, a sow from an aborting herd was purchased in one state by a swine breeder in another state, the purchaser having had no previous trouble with abortion in swine, but within six months after the introduction of the newly acquired animal from the aborting herd, over eighty per cent of the sows in the free herd aborted. Similar reports seems to incriminate the boar as a disseminator of infection. Whether or not the boar is merely a carrier of infection, or whether he is affected with the disease, remains to be demonstrated. Some breeders are of the opinion that contaminated feed is a source of infection of this disease. Whether or not a premise is relatively permanently infected after abortion occurs thereon has not yet been determined. If the causative agent or agents of this disease are resistant to exposure to atmospheric and climatic conditions, then barnyard fowls, pigeons, dogs and vermin must be considered a means of carrying infection. It may also be found that parasites, such as lice and probably also vermin, may be found to be factors in the spread of infective abortion in swine.

SYMPTOMS

Abortion usually occurs between the third and fourth month of pregnancy and the breeder will have no difficulty in identifying aborting sows. In some instances, the fetal membranes are not sloughed and their retention favors infection which is usually succeeded by metritis and sometimes by the death of the sow. Sows that have not sloughed the fetal membranes have a distressed appear-

ance, arched back, inappetence or diminished appetite and a bloody or purulent vaginal discharge. Unless the cases are properly treated, metritis becomes chronic and the inflammation of a purulent character, and there will be a creamy white purulent discharge. Such animals are unthrifty, become more or less emaciated and fit subjects for the ravage of other diseases.

Those cases in which there is more or less persistent metritis frequently become sterile.

TREATMENT

Preventive and control measures should be in the direction of improving sanitary surroundings, quarantining the aborting sows and care in the use of the boar. It is possible that the causative agent of this disease may soon be positively identified, and it is hoped that it will be feasible to produce some type of biologic agent that may be successfully used in immunizing against this disease.

Aborting sows should be absolutely isolated and if the placental membranes have not been sloughed, uterine irrigation of salt solution should be resorted to. It is not difficult to irrigate the uterus, providing a speculum is used to dilate the vaginal canal. The cervix of the uterus in these cases is usually relatively flabby and the irrigating tube can usually be inserted. Care must be exercised in this flushing-out method that the uterus is not distended too severely with the irrigating fluid. Such patients should be given clean, sanitary quarters, wholesome feed and injected once daily with quinin bisulphate, using 20-gram doses.

CHAPTER VI

STERILITY

Sterility, impotency or barrenness is inability of an animal to reproduce its kind. Sterility occurs in both sex.

OCCURRENCE

Sterility is relatively common in sows, particularly in animals that have aborted. It is not uncommon to find from one to six or eight sterile sows on the ordinary farm in the corn belt. This condition is not so common in boars, although an occasional case is observed.

CAUSE AND SYMPTOMS

Sterility in boars is usually the result of the absence of sperm cells. This condition is of most common occurrence in aged boars, or those that have been in excessive service. An occasional case of sterility occurs in either the male or female as a result of lack of development or malformation of the generative organs.

Sterility in sows may be due to extensive accumulation of fat, a result of overfeeding. The most common type of sterility in sows occurs particularly in those individuals that have aborted and suffered from retained fetal membranes. Some sterile sows in which sterility is secondary to metritis may come in heat, some regularly, others at irregular periods, and an occasional animal is observed that is almost, if not, constantly, in heat.

TREATMENT

The correction of sterility in sows is rather difficult, as this condition, as before stated, is usually secondary to metritis and abortion. The first principle, therefore, in successful breeding of swine is the prevention of abortion and metritis. The curative treatment of sterile sows is possible, at least in some instances. If sterility is caused from metritis it should be overcome by uterine irrigation and the use of quinin bisulphate, after which some of the apparently sterile sows will conceive. It is also advisable in those cases that do not come in heat to regulate the diet and administer yohimbin.

RETAINED PLACENTA AND METRITIS

Retention of the placenta and metritis has been reported to occur in sows that have aborted.

The symptoms observed in sows consist of vaginal discharge of a bloody fluid, arched back, irregular appetite and unthriftiness. There is frequently one to two degrees rise of temperature and there may be constipation.

A careful examination should be made, confining the animal in a crate or improvised chute. By means of a speculum the general condition of the vaginal mucosa may be determined and frequently also the mucosa of the body of the uterus. If fragments of placenta, putrid discharges, or pus are present in the uterus or vagina, irrigation with luke warm salt solution is indicated. Irrigation may be accomplished by means of a fountain syringe, making certain that it is clean before using. It is advisable to repeat the irrigation every day or every other day until the discharge ceases.

In treating cases of retained placenta in swine a proper diet should be provided and the patient placed in clean comfortable quarters. Laxatives should be given, preferably in the feed, using such agents as raw linseed oil in one-half to pint doses or salts in one to four-ounce doses. The injection of 20 grains of quinin bisulphate dissolved in water is of considerable value in these cases. This material should be injected into the axillary space or deep into the muscle tissue. Autogenous bacterins will be found of value in those cases that become chronic and in which there is a persistent discharge. Such sows should be isolated from other swine until the vaginal discharge has ceased.

CHAPTER VII

ANOMALIES AND DISEASES OF YOUNG PIGS

PERSISTENT URACHUS

The urachus is the communicating tube of the bladder and the allantoic cavity during fetal life and closes under normal conditions at the time of birth. Persistent urachus occurs most frequently in males. It is evidenced by constant dribbling of urine from the umbilicus.

In treating such cases it is advisable to see that the urethra is open. If portions of the umbilicus remain, a ligature may be applied and thus close the urachus. This simple treatment is usually sufficient, providing there is no infection of the umbilical structures. If the urachus has withdrawn into the body cavity a suture may be passed around it by means of a curved needle and then ligated.

ATRESIA ANI

The absence of an anus is relatively common in pigs. The cause of this condition is not known, but apparently is due to the failure of invagination of the skin to unite with the distal end of the rectum.

An artificial anus may be made in the majority of such cases by making a crucial incision through the skin in the anal area, seeing to it that the distal end of the rectum is also incised. The triangular skin-flaps may be sutured to the flaps of the rectum, or they may be removed, as granulation tissue soon unites the mucous membrane of the rectum and the skin.

OMPHALOPHLEBITIS, PYEMIC ARTHRITIS (NAVEL ILL)

This is an acute infectious disease of recently farrowed pigs characterized by inflammation of the umbilical tissues and suppurative arthritis.

Navel or joint ill has prevailed more or less extensively since the dawn of history. In some years this disease is responsible for the loss of a large percentage of the young pigs produced in certain communities. The disease occurs enzoötically and as an epizoötic, sporadic cases being rare.

Etiology.—This condition is caused by infection, but the specific exciting cause has not been positively identified. The Staphylococcus pyogenes aureus has been isolated from the lesions and was apparently present in practically a pure culture. A streptococcus appears to be the exciting cause in some cases, and in other cases the colon bacillus or some of its derivatives have been identified. Bacillus pyocyaneus sometimes causes this condition. The young animals are predisposed to the various types of infection by filthy surroundings and improper care. Some breeders claim that if the sows are per-

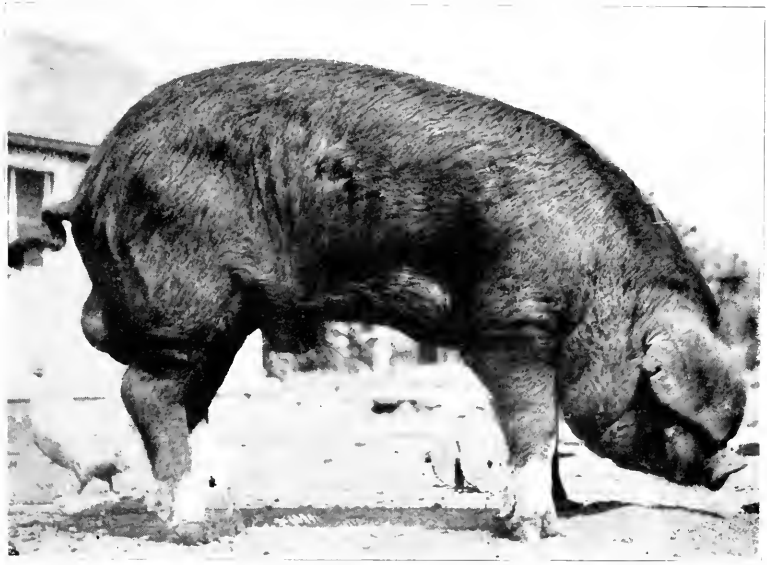

Fig. 42. RACHITIS. Typical standing posture of eighteen-months' old pig affected with rachitis and perhaps rheumatic disturbances also. Note the bowed front legs and enlarged bones.

mitted to farrow in clean quarters, and are maintained and fed in the proper way, that the pigs will not contract this disease.

There is evidence of the transmission of the disease *in utero* from the dam to the foal in horses, but such evidence has not been obtained in swine.

The infection gains entrance through the thrombi in the umbilical vessels. The infecting organisms extend in the thrombus, ultimately reaching the blood stream, by means of which they are disseminated throughout the body.

Lesions.—The manifestations of this disease are variable and depend upon the number and virulence of the infecting organism and their location in the body. The typical lesions consist of omphalitis and suppurative arthritis. Inflammation of the umbilical vessels may be limited or there may be an accumulation of pus, the inflammation being a typical suppuration and abscess formation. The lesions of the joints are variable. There may be a mild synovitis with limited or extensive infiltration and tumefaction of the structures surrounding the synovial membrane, in which case the synovial membrane is injected and tumefied. There is an increased amount of fluid and it will be turbid and perhaps contain flakes of coagulated material. In other instances the synovial membrane will be distended with accumulated pus and surrounding tissues may also be infiltrated with pus.

Metastatic abscesses may occur in various organs, as in the liver and spleen. If the infection extend to the bladder there will also be a purulent cystitis.

Symptoms.—The symptoms usually appear in the first week of life, although they may occur in the second or third week after farrowing. The affected pigs will be lame and indisposed to move. On examination one or more of the articulations are found to be swollen and sensitive, the tarsal joints being most frequently involved. There may be diarrhea. The course of the disease is usually brief, the pigs as a rule dying on the second or third day.

Treatment.—Curative treatment is not satisfactory. The disease can be controlled by the rigid application of sanitation. The farrowing houses and pens must be kept clean and all sows with affected pigs must be kept isolated. Some practitioners have reported good results by the use of a mixed bacterin, giving one or two doses to the sow during the last stages of pregnancy.

RICKETS

Rickets is a disease characterized by diminished calcification in the bones. This is essentially a disease of young animals. It is relatively common in pigs. Rickets is more prevalent in some localities than in others, and it appears to prevail more extensively during some years than others. Single cases may occur on a premise, but it is not unusual for 5 to 40 per cent of all suckling pigs on a farm

to become affected. The disease is of economic importance, because if affected pigs are not properly treated the disease becomes chronic, complications arise, the pigs will not develop and death of a large percentage of the affected animals is not at all unusual.

Etiology.—Rickets is apparently caused by disturbance of nutrition. The specific cause has not been discovered. The condition is the result of insufficient lime salts in the bones. Some have claimed that rickets occurs in animals that consume foods deficient in lime

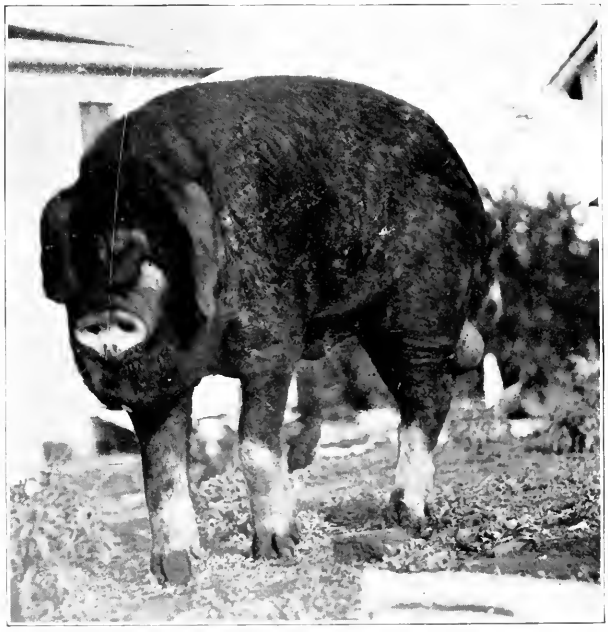

Fig. 43. RACHITIS. Showing the general attitude of the animal. Standing on the extreme tips of his toes makes walking difficult.

salts. Intoxication due to digestive derangements and intestinal parasitism have also been given credit for producing rickets. Still other investigators have maintained that rickets is due to infection. It is possible that disturbances of some internal secretion may be the cause of rickets. Improper feed and insanitary surrounding are undoubtedly predisposing factors that should be taken into consideration in the control of the disease.

Lesions.—The condition is not confined to any particular type or group of bones; however, the lesions are usually most pronounced

in the long bones of the legs, which are bent or curved, the animal being "bow legged." The bones are soft and so spongy that they may be cut readily with a knife. The epiphyses of the long bones are enlarged and irregularly club-shaped, while the shaft is also irregularly thickened. There is a subperiosteal, spongy layer. The yellow marrow is red in color and is of a gelatinous consistency. There may be ulceration of articular surfaces, and the flat bones of the cranium and pelvis may be thickened and rarefied. The nares and mouth may be practically obliterated by the enlarged rarefied nasal bones and hard palate; the teeth may appear deep-set on account of the tumefaction of the alveolar tissue. In advanced cases,

Photo by F. F. Brown.

Fig. 44. RACHITIS. Hind quarters badly affected.

lesions may be found elsewhere causing disturbances of the digestive or respiratory system.

Symptoms.—The first evidence of the disease is weakness, diminished or depraved appetite, and diarrhea. But lameness or stiffness of gait succeeded by bending or arching of the bones is the first positive indication of rickets. At this stage the lying posture is almost continuously assumed. When the affected animals are made to arise they complain of pain by grunting and squealing, and not infrequently they will walk on the carpal joints. There may be nervous disturbances evidenced by dizziness, somnolence, and convulsions. As the disease progresses the enlarged epiphyses become evident and appear as a swollen condition of the articulation. Sim-

ilar bony enlargements may also occur elsewhere. The bulging of the long bones of the front legs exerts undue pressure upon the ribs, which results in disturbed respiration, and the vertebral column is variously curved, upward, downward, or laterally.

This disease is of a chronic nature and continues for months unless death intervenes early, which is exceptional. Diagnosis is not difficult after the changes in the bones are evident, while the chronic nature of rickets is sufficient to differentiate this condition from articular rheumatism. Tuberculous osteitis is differentiated from rickets by

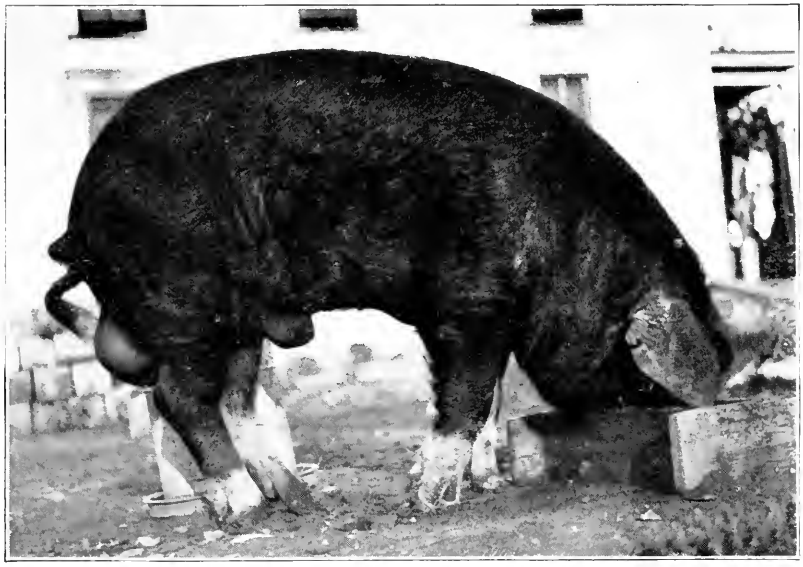

Fig. 45. RACHITIS. This illustration shows clearly the attitude of standing far over on the toes, particularly of the front feet.

the limited infection and the less extensive tumefaction, and lack of density of the affected bones.

Rickets should be differentiated from paralysis due to disorder of nerve-tissue, see page 267, and osteomalacia, see page 232.

Treatment.—Treatment of rachitic swine is advised only in the early stages of the disease. Those in the advanced stages should be destroyed. The first thing to do is to place the animals in sanitary quarters, then medicinal treatment consists of administering lime in some form. Prepared chalk may be used. Bone meal is also of

value, precipitated calcium phosphate is highly recommended by some, and calcium chlorate may be found serviceable. Preventive measures, as proper feeding and care, practically insure against the occurrence of this disease in swine.

SCOUR IN PIGS

Pig scour is a serious menace to the swine industry. The annual loss from pig scour has been estimated at from seven to ten million pigs in the United States. Many farmers have lost ten to twenty-five per cent of their pig crop for several successive years from pig scour. Farms have been observed in which two hundred to two hundred and fifty pigs have died in one season from pig scour out of a total pig crop of not to exceed three hundred. The disease has been proportionately more prevalent in the centers of greatest hog population.

Pig scour usually occurs in relatively young pigs, the majority of cases occurring within the first ten days, although the condition may occur in six-weeks old pigs.

Etiology.—There is apparently no single cause that is responsible for the various cases of scours. Unfavorable surroundings, such as damp, dark, and dingy hog houses, predispose to this condition. In some instances, mammitis of the sow is a causative factor. Improper foods, such as moldy or fermented slops, probably result in elimination of injurious substances in the mother's milk that will create in the pigs digestive disturbances resulting in diarrhea. It is probable also that intestinal parasites may be responsible for catarrhal enteritis and an associated diarrhea. Artificial feeding is likely to produce digestive derangement and diarrhea, and exposure to extreme temperature variations must be considered as a causative factor of pig diarrhea.

Infection is probably the most important cause of pig scour. No specific bacterium has been isolated that is responsible for all of the cases of infectious scour. The B.coli communis, B.suipestifer, B.suisepticus, B.paratyphoid A & B are the microbian agents most commonly found in these cases. The B.pyocyaneus, and various pyogenic micrococci are sometimes demonstrable in the discharges of affected cases or in the lesions of carcasses of pigs dead of the malady.

The rapid spread of the disease in a litter of pigs and the dissemination from litter to litter and from farm to farm is strongly indicative of the infectious nature of pig scour.

Some investigators have reported the finding of a coccidia that appeared to be responsible for the loss of many pigs in which scour was the principal manifested symptom.

Lesions.—There will be soiling of the tail and hind legs. Unless the disease has been very acute the pig will be thin and light in weight for its size. The intestinal contents are usually quite liquid and may be putrid. Larval parasites may be present in the intestinal content. Areas of congestion of the intestinal mucosa may occur, or if the affected pig has a subacute or chronic form of the disease, inflammatory disturbances and ulceration may be noted. If the scour has been due to irritants there will be inflammatory lesions of the gastric mucosa, the extent of which will depend upon the nature of the irritant. The lesions evidenced in pig scour are not definite and constant.

Symptoms.—Diarrhea is the characteristic symptom of pig scour. The evacuations in the beginning are pasty in consistency and of a gray or slate color. Later the discharges become more watery and have a very disagreeable odor. During this stage the pig's tail and hind parts become soiled. The longer the disease persists the more fluid and fetid are the discharges. The appetite is usually good at the beginning but the affected pig soon loses desire for food. The affected pigs evidence abdominal pain by kicking the belly, squealing, grunting and by their restlessness. They have a dejected appearance, standing with head down, tail drooping, marked tucked abdomen and rough coat. They emaciate rapidly, become weak and die of exhaustion.

Treatment.—If possible, remove the cause. Give proper diet to the sow and have clean, wholesome surroundings for the pigs. Medicinal treatment of the affected pigs, particularly those depending entirely upon their mother's milk, is difficult. It is a good practice to hasten the removal of the irritating substances from the bowel, by the use of castor oil or similar purgative. If the diarrhea persists after the correction of diet and the action of castor oil, small quantities of bismuth subnitrate may be used to advantage. Intestinal antiseptics, such as salol and the sulphocarbolates of sodium, calcium and zinc, are exceedingly beneficial where they can be administered frequently.

The injection of bacterins composed of the microbian agents associated with pig scour is of value according to the reports of some practitioners.

Prevention of pig scour is far more satisfactory than the treatment of affected animals. Breeders should be advised to keep pregnant sows in clean quarters, particularly during farrowing time. Pigs may be immunized against the various microbian agents cited as probable causative factors in pig scour, and the practice of immunization of small pigs against scour may be the proper solution of overcoming the losses incidental to this malady.

PULMONARY ASCARIDIASIS

There has been an unusual loss of little pigs during the last few years, more especially during the last two years, in the United States, and from investigations it is apparent that these losses have been largely due to an embolic pneumonia of parasitic origin. Many swine breeders have lost fifty per cent of their pig crop, and instances have been recorded where 80 to 90 per cent of pigs have died as a result of the invasion of the lung with parasites. Loss occasioned by these parasites is not only from the death of the little pigs but from the loss of condition of shotes and larger swine.

Etiology.—The specific cause of pulmonary ascaridiasis is the larval form of the Ascaris suum. The life cycle of this parasite according to the investigations of Stewart, Ransom, and Foster, is briefly as follows: The ovum of the ascarid is eliminated from the adult in the intestine of the swine and passes out with the feces. The ovum incubates outside the animal body. The time required for it to pass through the various stages and become infective depending upon the temperature. It requires about three weeks at a temperature of 75° F. and two weeks at a temperature of 90° F. It will not become infective when incubated at body temperature; therefore it is necessary for the ovum to pass out of the body of the swine before it successfully incubates.

The infective incubated ova are ingested by swine on their food or in their drink and may be obtained by the suckling pig from the teat of the sow. The ova may also be obtained by rooting in infested pens. After the incubated ova are ingested they pass with the food into the stomach but are not liberated from their capsule until they reach the intestine. After emerging from their encysting capsule they begin migration into the tissues. Within four or five days some of them are found in various tissues but only those that reach the lung successfully develop, those remaining in other tissues ultimately perish. When the larval stage is completed the larvae pass up the

trachea to the pharynx and are then swallowed, and those that are not passed out with the feces develop to maturity in the small intestine.

Lesions.—The lesion resulting from the invasion and development of the larval ascarids in the lung is primarily an embolic pneumonia with or without abscess formation. There is usually a marked serous infiltration or edema of the pulmonary tissue. There may be hemorrhages of variable size. Microscopically larvae may be demonstrated in the scrapings from the bronchial mucosa or from the embolic pneumonic centers.

Symptom.—Cough, nasal discharge, unthriftiness, and impaired appetite are the usual symptoms manifested in an uncomplicated case of pulmonary ascaridiasis. These symptoms develop rapidly in little pigs, and if the infestation has been extensive the pig usually dies within four to seven days after the first manifested symptoms. The symptoms evidenced in pigs that are six weeks old or older are less intensive, and the majority of infested animals at this age recover although they will show loss of condition and do not develop properly.

Treatment.—Thus far no medicinal treatment has been found that is of value in overcoming this condition. Inhalations of medicated vapors may be of some value in eliminating some of the larvae from the bronchial tubes and trachea, particularly in the larger pigs. However, the condition is easily prevented by the periodic administration of santonin capsules, thus eliminating the adults from the breeding swine, and by the rigid enforcement of sanitary regulations. It will be found that rotation of pastures and frequent changing of quarters will be of great value in reducing the losses of pigs occasioned by the larval form of the Ascaris suum.

Infectious Rhinitis ("Bull-Nose or Sniffles")

Infectious rhinitis is probably a specific infective disease of swine characterized by inflammation of the mucous membrane of the nasal chambers and related sinuses and by involvement and deformity of the facial bones. This disease may be the same as infectious nasal catarrh, excepting that it is more severe and destructive.

This condition is rather prevalent and is responsible for the loss of large numbers of pigs in various locations every year. The development of "bull nose" has been observed in pigs that have been kept in pens that have been used for swine for several consecutive

years, and in many instances it is found that the breeding stock on such premises is of the same origin and that the affected animals are inbred. As a rule, when the disease first appears on a farm only a few swine become affected but each succeeding year the percentage of affected animals increases, and by the fourth or fifth year after the disease first appeared from one-fourth to one-third of the pig crop becomes affected. It is not uncommon to find the disease affecting swine that have been recently introduced onto the premises where the disease had previously existed. This fact indicates that the infection persists on a premise or that swine on an infected farm may be carriers of the infection.

Etiology.—Filthy pens, improperly ventilated hog houses, the continuous use of the same quarters and inbreeding are factors that predispose to infectious rhinitis. The Bacillus pyocyaneus has been suggested by Dimock as the probable cause of this disease. This micro-organism is usually distributed in soil and manure heaps, and could, therefore, readily gain access to the nasal mucosa. It can be demonstrated in the discharges and lesions of a large percentage of affected animals.

Lesions.—In the beginning there will be noted an acute catarrhal inflammation of the nasal mucosa manifested by congestion and tumefaction. As the disease progresses the inflammatory process becomes purulent and there is usually a deposit of a dirty gray, sticky exudate upon the mucosa. The infection may destroy variable sized areas of the mucous membranes. Soon after the necrosis of the mucosa there will be noted a bulging of the facial bones resulting in more or less deformity. In some cases the hard palate is forced downward, diminishing the oral cavity. The bulging of the facial bones is due to an increased volume, the result of hyperplasia. The inflammatory and necrotic processes extend from the nasal mucosa and involve the mucous membrane of the various facial sinuses and the conjunctiva is usually similarly affected. Affected animals are usually unthrifty, emaciated and small for their age. In extreme cases, suppurative centers may occur in the various lymph-glands.

Symptoms.—Sneezing is usually an early symptom of infectious rhinitis. There will be a watery discharge in the beginning which later becomes purulent or mucopurulent. The affected swine have a tendency to root in their food but they eat little, consequently they do not gain in weight. There will also be a mucous or mucopurulent discharge from the conjunctiva, and the eyes may be closed

because of the adhesion of the lids. In the latter stages there will be bulging of the facial bones which interferes with respiration and is usually associated with a peculiar blowing noise.

The length of duration of this disease is variable. In those cases in which there is apparently a marked toxemia due to the absorption of the bacterial products the course is relatively shorter than in those cases in which the disease is localized in the mucosa of the nasal chambers. Swine that have been affected with infectious rhinitis for more than one year have been observed but such cases are the exception.

Diagnosis.—Infectious rhinitis is frequently confounded with necrotic stomatitis. Necrotic stomatitis is characterized by an intense inflammation involving the buccal mucosa, in which the inflamed membranes pass through the successive changes of congestion, tumefaction, necrosis and erosion, and the affected tissue has a peculiar disagreeable pungent odor. The lesions of infectious rhinitis are without odor and the progress of this disease is much less rapid than stomatits. Infectious rhinitis is differentiated from catarrhal rhinitis because of its infectious nature and is differentiated from infectious catarrhal rhinitis by the fact that the bones are not involved in the latter.

Treatment.—Clean pens, properly ventilated hog houses, changing of the quarters for swine every year or every second year and proper selection of breeding stock will be found of value in the prevention of infectious rhinitis. When the disease is observed in the very early stages, medication by inhalation of such agents as oil of eucalyptus may be of value, providing the patients can be confined in practically air-tight houses. It may be possible when the specific cause has been demonstrated beyond a reasonable doubt that a biologic agent may be found that will immunize swine against this disease. Cases in which there is bulging of the facial bones are practically hopeless and should be destroyed.

STOMATITIS IN SUCKLINGS (SORE MOUTH IN PIGS)

The various and usual types of stomatitis, according to pathologic classification, have been described in the chapter on the digestive system and stomatitis due to the B. necrophorus is described under the heading of necrobacillosis but stomatitis occurring in suckling pigs is of such importance that a special discussion is justifiable.

Stomatitis is suckling pigs is very common and is directly or

indirectly responsible for extensive losses of pigs, particularly on farms where swine have been maintained for many years. This condition is more prevalent than is ordinarily suspected because the majority of swine breeders rarely report the loss of a little pig and they usually assume that such losses are unavoidable. Stomatitis is much more prevalent in pigs that are farrowed and kept in insanitary pens and surroundings than in pigs farrowed and maintained in clean quarters and sanitary surroundings. After the disease has once occurred in pigs on a given farm it is prone to recur in the pigs farrowed on the same premises thereafter.

Etiology.—Stomatitis in pigs is probably due to a variety of causes. Insanitary surroundings, improper housing and feed are important predisposing factors. The condition probably occurs most frequently in pigs in large litters because they are likely to be under-nourished and are prone to injure each other while attempting to nurse. Any abrasion will provide an avenue of entrance for various infecting microörganisms.

The following bacteria have been isolated from the lesions of stomatitis in suckling pigs: pyogenic micrococci, steptococci, B. pyocyaneus, B. necrophorus, B. coli communis and others. Practically pure cultures of any one of the foregoing microörganisms have been obtained from different cases of this condition. The B. pyocyaneus and B. necrophorus are more destructive than the pyogenic cocci or the colon bacillus. These infective microörganisms are practically universally distributed but probably are not capable of invading tissue unless they have been injured or damaged. When one pig in a litter becomes infected the infecting microbian agent is transferred to the sow's teat and other pigs become infected.

Lesions.—The lesions are as variable as the etiologic factors and are probably largely determined by the infecting agent. The lesions may occur on the lips, snout, or any portion of the mucous membrane of the mouth or tongue. The lesion associated with pyogenic cocci is first a hyperemic or hemorrhagic tumefied area that has a tendency to form a pustule; more rarely diffuse surface suppuration succeeds the hyperemic stage. The pus in these cases is dirty white or tinged with yellow. The lesion is usually quite superficial, although cases have been observed in which the submucosa or subsubcutis was undetermined for some distance.

The B. pyocyaneus produces a more extensive lesion than the pyogenic cocci. The progress of the disease is rapid and tissue destruc-

tion extensive. There is a tendency for this infection to permeate subsurface structures and become diffuse. It appears from the cases observed that B. pyocyaneus has a tendency to invade the tissues of the snout and nasal chambers and is prone to produce the condition described elsewhere as "bull-nose." The pus in lesions resulting from B. pyocyaneus is green or greenish yellow in color.

Lesions produced by B. necrophorous are described on page 319 under the head of necrotic stomatitis.

The B. coli communis may produce suppurative or non-suppurative inflammatory lesions. These lesions are usually circumscribed and the pus is of a dirty white color.

Symptoms.—This condition occurs in the first few days after farrowing. Rather extensive lesions have been observed in one-day old pigs, indicating infection at the time of or immediately after farrowing. It occurs in pigs up to three weeks of age but is not common in pigs after they are ten days old. Affected pigs are listless; they have a tendency to remain quiet and are not active and playful as is the healthy pig. In a few hours or within a day or two there is marked depression and there may be diarrhea. If an affected pig is caught and carefully examined lesions will be found that are responsible for the condition. Only one pig in a litter may be affected but it is not unusual to find one-half or even the entire litter affected.

Treatment.—By proper care and treatment it is possible to prevent losses of pigs from stomatitis. Every pig should be carefully inspected at least once daily until ten days old by the attendant to ascertain their exact condition and incidentally to note any disturbance that may be overcome readily. All infected and especially necrotic tissue should be removed by a curette and the wound thoroughly saturated with tincture of iodin. One or two such treatments usually is sufficient and the large percentage that recover will probably be surprising to those who have not attempted to relieve these cases. Clean quarters should be provided and each sow and her litter should be kept separate to prevent spread of the infection.

CHAPTER VIII

ORGANS OF LOCOMOTION

Sore feet
Fatty changes in muscle
Rheumatism { muscular / articular
Polyarthritis
Osteomalacia
Osteomyelitis (purulent)
Trichinosis
Cysticercosis
Sarcosporidiosis
Tumors

Under this heading will be considered the diseases of the voluntary muscles, bones, and joints. A great variety of malformations of the organs of locomotion have been observed in swine. Multiplicity of legs or duplication of portions of a leg are relatively common, and fusion of parts ordinarily separate is occasionally encountered. These abnormalities may be so adverse to the existence of the animal that it dies soon after birth, or the anomaly may be so slight that the animal is in no way inconvenienced and develops into maturity.

Injuries of various kinds are prone to damage and possibly destroy the usefulness of the part affected, and thus interfere with the locomotion of the animal to such an extent that it must be sacrificed. Muscle wounds usually give little trouble in swine because of their marked resistance to infection, while fractures are not so troublesome in swine as in the larger animals, and are usually repaired rapidly and frequently without intervention of the surgeon.

SORE FEET

The feet of swine that are kept on pavements or driven long distances over hard roads become sore. This condition is attracting the attention of serum producers who are required by the government regulations to keep the hyperimmune swine on concrete or other similar floors. Those producers depending upon tail bleeding are having considerable difficulty in keeping the hyperimmune swine for the required time because it is difficult to keep the pens free from filth when bedding is used.

Sore feet due to rough, hard roads and pens also occasion some trouble in swine. This condition caused more concern in former

times, when swine were driven considerable distances to market, than at the present time. However, it also is a problem that confronts the serum producers.

About the only treatment is to provide ample, clean bedding or turn the swine out to pasture.

FATTY CHANGES IN MUSCLE

Fatty changes of muscle tissue have been observed in suckling pigs by various investigators. This disease or condition is characterized by an extensive fatty degeneration of the muscular tissue of the entire body. The cause of this degeneration is not known, although it may be a sequel of inbreeding. It affects pigs from a few days old to three or four weeks of age. The muscle has a white appearance, as if it had been cooked. Similar changes may also be noted in the lymph glands, liver, and kidneys. The affected pigs cease to nurse, lie on the ground, are weak, and may have diarrhea. The disease almost always terminates fatally, the pigs sometimes not even struggling when they die, but in other instances convulsions precede death. Thus far no medicinal treatment has proved of value, but the disease may be prevented by proper care and the frequent introduction of new breeding stock.

MUSCULAR RHEUMATISM

Rheumatism may affect the muscular tissue, but more frequently it affects articulations in swine.

The cause of muscular rheumatism has not been positively identified. No doubt undue exposure predisposes the animal to this condition, but there must also be some active cause, such as infection or absorbed injurious chemical substances.

Lesions.—Muscular rheumatism primarily affects the connective tissue of the muscles. The lesion consists of a serous or hemorrhagic infiltration between the muscle bundles and fibers, and rarely of necrosis of the intramuscular fibrous tissue. The muscle fibers are affected with parenchymatous or fatty degeneration, and the surrounding arterioles and capillaries are engorged.

Symptoms.—The principal symptom consists of expression of pain, especially evident when the animal moves. Locomotion is interfered with, and there is a shifting lameness. Some cases of so-called paralysis resulting in dragging of the hind legs are probably muscular rheumatism. If the disease is sufficiently extensive the affected

animals refuse to eat. Muscular rheumatism is differentiated from trichinosis by the periodic shifting lameness of rheumatism and by the general absence of systemic disturbances. It may be necessary to distinguish it from rickets, which is not difficult, since the latter is a disease affecting the bones.

Treatment.—Provide good quarters where the animal will not experience wide variations of temperature within a short time. Laxatives aid some form of salicylates or their derivatives are usually of value, but must be given judiciously to avoid impairment of digestion.

ARTICULAR RHEUMATISM

Articular rheumatism sometimes occurs in swine. This condition affects swine that have been unduly exposed, but probably the exciting cause is infection.

Articular rheumatism is esentially an inflammation of the periarticular structures, including the synovial membrane. The inflammation may be serous, fibrinous, or hemorrhagic, and in extreme cases it may become purulent. The exudate is accumulated in the periarticular structures and occasionally in the joint cavity. The synovia becomes admixed with the inflammatory exudate and appears turbid, bloody, or purulent, and may contain coagulated fibrin; the articular surfaces are rough. In cases of long standing the articulation is surrounded by varying quantities of fibrous tissue which may cicatrize and cause deformity. Various articulations are affected, but the lesions are principally confined to the carpal, tarsal, stifle, and fetlock joints.

Symptoms.—The onset of this trouble is sudden. The affected articulations become swollen and are very sensitive to palpation; the animal refuses to place weight on them or, if compelled to do so, expresses pain. If articulations of more than one leg are simultaneously affected the animal remains lying down, arising only after considerable urging. There is usually some rise of temperature and a diminished desire for food, or inappetence. The disease runs a variable course, the attacks being intermittent. An attack usually continues for about two weeks, then the animal apparently recovers, but sooner or later the attacks recur.

Treatment.—The treatment for articular rheumatism is practically the same as for muscular rheumatism. Provide good quarters, and administer laxatives and salicylates. The outcome of the disease is uncertain, and if the animals are in butcher condition they should

be disposed of several days after the cessation of the symptoms of an attack.

POLYARTHRITIS

Polyarthritis is a name applied to a condition in which there is involvement of various joints of the legs. This condition has been quite prevalent in some sections of the country. The number of cases observed varies during different years. The disease is of economic importance because it results in unthriftiness and therefore the affected animals do not develop and fatten normally. The disease does not appear to be confined to any particular type or breed of swine and occurs equally in males and females.

Etiology.—It has been stated, although never positively proved, that confining pigs on cement floors or cold damp quarters is an important predisposing factor. According to the findings in abattoirs, there are proportionately more cases after severe winters or cold springs than after mild winters. The B. pyogenes has been claimed to be the specific cause of polyarthritis. It may be that this disease is a chronic condition resulting from navel infection.

Lesions.—The lesions are variable depending upon the intensity and chronicity of the processes. There may be a mild inflammation of the synovial membranes with limited or extensive infiltration and tumefaction of the perisynovial structures. In the early stages the synovial membrane is congested, and as the disease progresses varying quantities of fluid accumulate in the joint cavity. The accumulated fluid will be turbid and may contain coagulated material. In the later stages of the more chronic cases there will be a a thickening of the synovial membrane due to fibrous proliferation. Fibrous formation may involve consideration of the perisynovial structures and be sufficiently dense to render the joint immobile or nearly so. The articular cartilages may be eroded and there may be organization and fibrous proliferation within the joint cavity, thus rendering movement impossible. The affected animals are not fully developed and in the more severe cases are not in good flesh.

Symptoms.—In the beginning the affected animals show locomotory disturbances and the joints are swollen and sensitive. When the disease has assumed the chronic form the affected animals appear unthrifty and there may or may not be visible enlargement of the joints. There will be interference with joint action.

Treatment.—Prevention offers the only solution of overcoming the

losses incident to this disease. Swine should be properly housed and bedding provided to prevent contact with cold damp floors. Care should be exercised at farrowing time to diminish the possibility of navel infection. Acute cases may be relieved temporarily or possibly permanently by hot packs applied to the swollen joints.

OSTEOMALACIA

Osteomalacia is a disease of mature swine characterized by a decalcification, softening and fragility of the bones. This disease is not of common occurrence in swine; however, occasional cases are encountered by practitioners. The disease is most common in sows and is prone to occur during the lactation period and particularly when the sows are being suckled by a large litter of pigs. In some instances several sows on the same farm are affected with this disease. Osteomalacia may occur in barrows and boars, but reports of such cases have not been recorded in available literature.

Etiology.—The specific cause of osteomalacia has not been determined, but it appears to be a condition resulting from an insufficient amount of lime in the food that is capable of being assimilated. This disease may properly be classed as a disease resulting from malnutrition. In instances where only one animal is affected on a farm where several swine are maintained, it is probable that there is some anatomical or physiological defect that is the primary predisposing cause of the condition. When several swine are simultaneously affected on a farm the feed will usually be found deficient in lime salts.

Lesions.—The bones most frequently involved are those of the extremities, ribs, vertebral column, skull, and pelvis. The affected bones become enlarged and less dense, the narrow cavity of the long bones is increased in size and filled with a gelatinous, usually hemorrhagic marrow, while the osseous tissue is less dense and more fragile and the periosteum separates from the bone readily. Fractures are very common.

Symptoms.—The disease is usually initiated by digestive disturbances, which are succeeded by emaciation, impaired and usually difficult locomotion, fractures, and various deformities. The disease finally assumes a chronic form, evidencing periods of temporary improvement and relapse. This is essentially a disease of mature animals, and this factor is of value in differentiating osteomalacia from rickets. The prognosis is favorable in cases showing no marked

enlargement of bones or deformity, and unfavorable in those cases showing deformity.

Treatment.—Provide sanitary surroundings and proper food, correct digestive disturbances and administer lime salts in the feed or water.

PURULENT OSTEOMYELITIS

Inflammation of the bone marrow occurs in swine. This condition is sporadic, and is most frequently observed in young animals.

Etiology.—Purulent osteomyelitis is caused by infection. Various pyogenic microörganisms have been identified, such as Staphylococcus pyogenes aureus and albus. Streptococcus, and in one instance the Bacillus pyocyaneus, was isolated and apparently occurred in pure culture. There is probably some predisposing cause, such as hog cholera, but all of the cases observed have shown no lesions of cholera or other than the primary disease.

Lesions.—The ribs are most frequently affected. The bone marrow becomes hyperemic and invaded with leukocytes and inflammatory products, and the internal pressure causes the bone to become enlarged and the marrow cavity to be increased in size. The marrow and the inflammatory exudate disintegrate and form pus. As pus is produced the bone becomes larger and round, although it may show some irregularities in shape. The pus in the marrow cavity may erode the bone tissue and discharge, thus producing a fistulous tract, but more frequently the pus becomes caseous and may later undergo calcification. Suppurative processes are rarely observed in other bones.

Symptoms.—There is little outward manifestation of purulent osteomyelitis other than the formation of a barrel chest (the ribs form a wider arch, the thorax appearing almost round in cross-section), and the prominent tumefied ribs. If the affected animal is in good condition the ribs are not visible. These cases are usually of long standing, and the disease is essentially chronic. Antemortem diagnosis is rarely made. Purulent osteomyelitis can be distinguished from osteomalacia by the localization of the process in the ribs.

Treatment.—Medicinal treatment is of no value.

TRICHINOSIS

Trichinosis assumes two forms, intestinal and muscular. Both types occur in the same animal, the intestinal preceding the muscular form.

This disease is quite prevalent, particularly in North America. From two to eight per cent of American hams imported into Germany have been found infested. The disease is less prevalent in Europe, or at least the statistics so indicate.

The cause of trichinosis is the Trichinella spiralis. This is a small, round worm, the adult rarely exceeding one-twelfth of an inch in length. The life cycle of the parasite is as follows:

The larvæ gain entrance to the digestive tract in meat, where the surrounding capsule is dissolved by the digestive juices, and thus are liberated within twenty-four hours. They pass into the small intestine, where they become sexually mature in about three days. About five days after copulation, or within ten or twelve days after ingestion, the pregnant female and the male are found in the crypts of Lieberkühn and the female begins to deposit her young in the form of living embryos. This process is continued by the female for from six to eight weeks, during which time she produces from eight to fifteen thousand young. A few of the embryos pass out with the feces, but most of them pass through the tissue of the intestine, some of them gaining entrance to capillary lymph and blood vessels, while others wander through the tissue. Those passing into the lymphatics ultimately reach the blood stream, as do those passing directly into the blood capillaries, and finally they are distributed by the blood or by direct migration to all parts of the body. The embryos thus distributed pass into various tissues, but as a rule only those entering the muscular tissue survive and develop. The embryo matures into a larva in the muscle in a period of about two months; by this time the irritation produced has resulted in the formation of a capsule. These encapsulated larvæ will retain their vitality in swine for a period of about eleven years, but the capsule and some of the interior of the cyst undergo calcification, the process beginning about one or one and a half years after encapsulation.

Swine become infested by eating trichinous flesh of pigs, rats, or other animals, or from eating the excretions of infested animals. All breeds of swine, regardless of age, are equally susceptible. Trichinosis is most prevalent in swine kept in small pens, especially when sanitation is not observed.

Lesions.—The adults produce an intestinal catarrh which is most evident in the proximal portion of the intestine. Soon after the embryos begin to migrate the mesenteric lymphatic glands become enlarged, and there may be pulmonary congestion and parenchym-

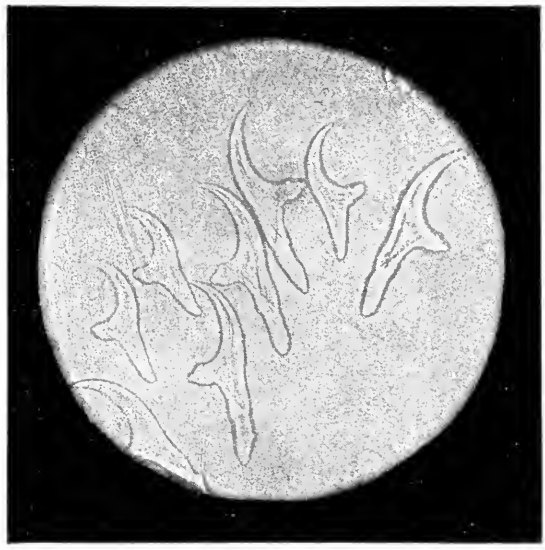

Fig. 46. Single hooks of a dangerous measle worm, greatly enlarged. (Ostertag.)

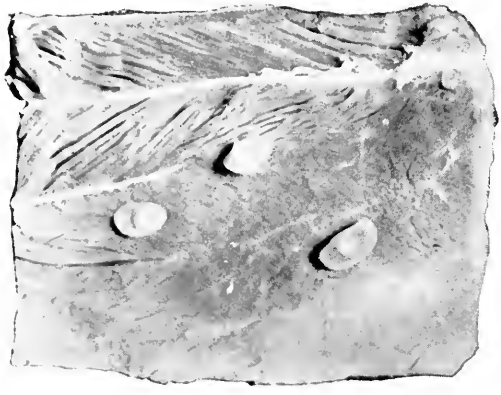

Fig. 47. Musculature of hog with measle worms appearing on the cut surface. (Ostertag.)

Fig. 48. Pork measle worm with protruded scolex slightly enlarged. (Ostertag.)

atous degeneration of the liver and kidneys. The affected muscle first becomes swollen, and appears of a gray color. About eight weeks after the embryos begin to migrate, small gray or grayish-white specks may be detected in the muscle tissue. This condition is especially evident in the diaphragm, intercostal muscles, muscles of the cervical region, and tongue. If the lesions are of long standing they will contain calcium salts, which may be detected as small, gritty masses. Microscopically, in the first year of muscular trich-

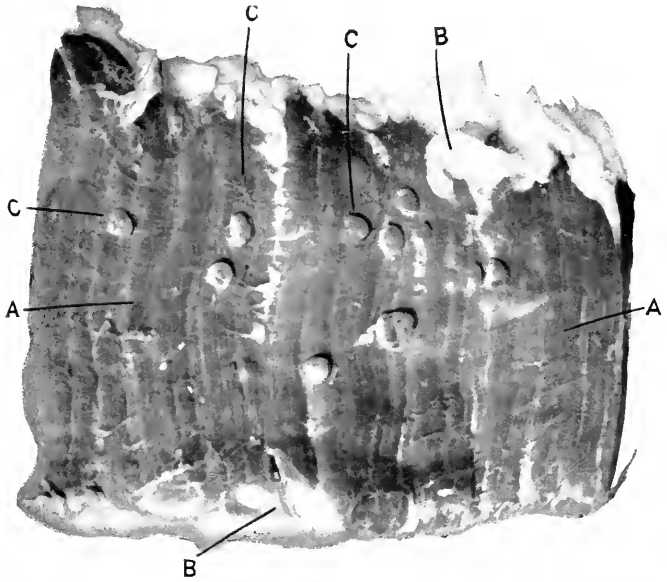

Fig. 49. CYSTICERCOSIS (Pork Measles). A, muscle; B, fat; C, cysticercus cellulosae.

inosis the larvæ can be readily detected as small, coiled, thread-like worms within a capsule.

Symptoms.—Clinical trichinosis has been observed only in experiments, or at least the disease has not been recognized by the clinician. Experimentally, intestinal trichinosis becomes evident in from three to six days after infestation. The disease is manifested by the following symptoms: inappetence, vomition, diarrhea, colic, arched back, unwillingness to move, and rapid emaciation. Evidence of muscular trichinosis appears in about two weeks, and is manifested by the following symptoms: rubbing against posts or other objects, stiffness,

assumption of the lying posture the greater part of the time, dyspnea, dysphagia, and rise of temperature. These symptoms, in the order mentioned, continue for four to six weeks, and the affected animal apparently recovers. Diagnosis of trichinosis may be possible clinically, but the absolute diagnosis depends upon a microscopic detection of the parasite.

Treatment.—Medicinal treatment may be of some value in eliminating the adults from the intestine, but the disease is rarely diagnosed before death. The muscular form of the disease is not relieved by

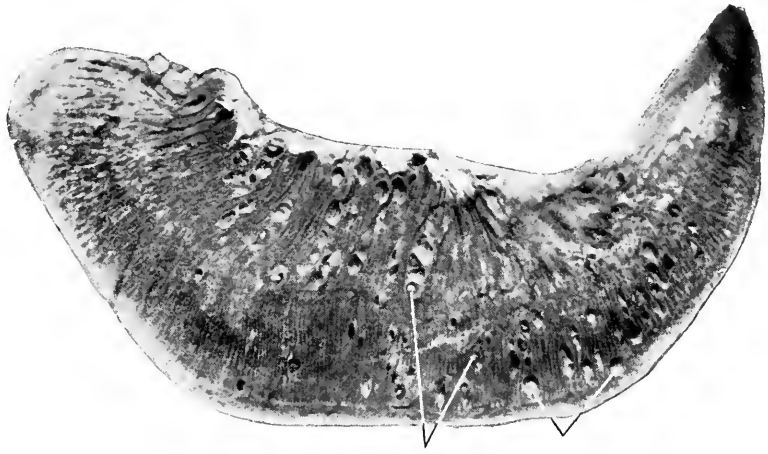

Fig. 50. Section of a measly hog tongue. (Ostertag.)

treatment. Prophylactic measures, such as general sanitation and eradication of rats, should be instituted.

CYSTICERCOSIS (MEASLES)

Cysticercosis is a condition due to the invasion and development of the cystic form of a tapeworm. This condition prevails more or less in the swine of practically all countries. Cysticercosis in the muscular tissue of swine is due to the cystic form of the Tænia solium, the cystic form of this parasite being designated Cysticercus cellulosæ.

Etiology.—The life cycle of the Tænia solium is as follows. The ovum of the adult, which resides in the intestinal tract of man, is eliminated in the feces. Swine eat the contaminated feces and the

digestive juices dissolve the shell of the tapeworm ovum and liberate a six-hooked embryo. The embryos bore through the walls of the stomach, some of them entering the blood vessels, and are thus distributed by migration and the circulation of the blood to all parts of the body. Those deposited elsewhere than in the muscular tissue do not as a rule develop. The development of the parasite is rather slow. The embryo assumes the form of a cyst and in twenty days' time is about the size of an ordinary pinhead. By this time the head of the future tapeworm is visible as a mere point. About two months after the embryo lodges in the muscle it has attained the size of a small pea, and in three months the embryo has matured, as is evidenced by the presence of sucker disks and a rostellum of hooklets on the head of the future tapeworm. Should a human being consume uncooked swine flesh containing one of these mature bladder worms the digestive juices would dissolve the capsule and liberate the scolex which would attach itself to the intestinal mucosa. From

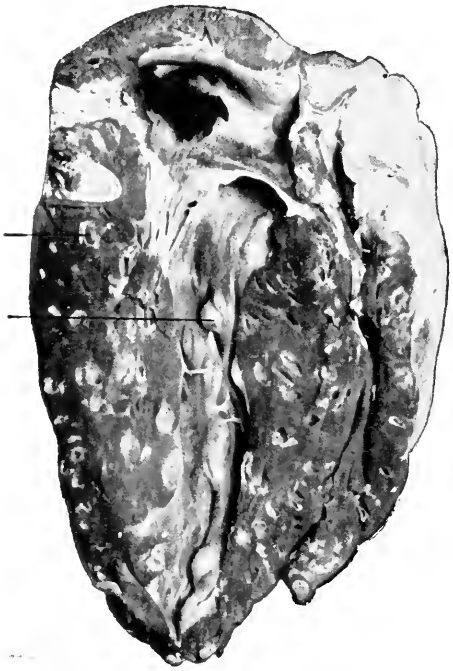

Fig. 51. Section of a measly hog heart. (Ostertag.)

three to five months are required from the time of ingestion of the bladder worm by the human until ripe segments are eliminated. One ripe segment contains from ten to thirty thousand ova.

Swine become infested by ingesting water or food contaminated with the ova of the Tænia solium. This condition occurs only in hogs that consume human excrements and young swine are more susceptible to this condition than are the aged animals.

Lesions.—The presence of the cysts typifies Cysticercus cellulosæ. These cysts vary in size from visible points to small beans. They are usually oval in shape, and the scolex can readily be recognized

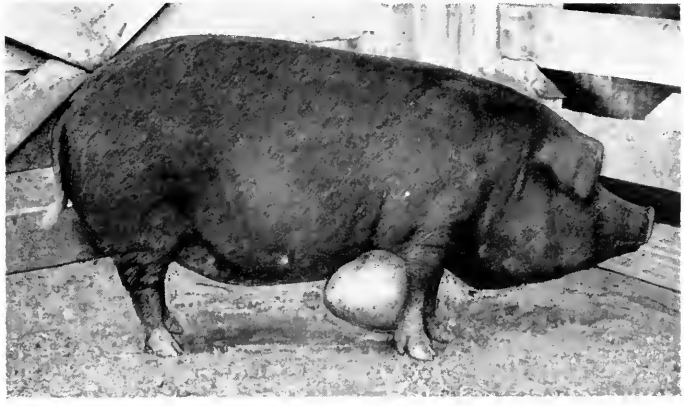

Fig. 52. PEDUNCULATED FIBROMA.

within as a white point or body. The cyst is surrounded by a thin capsule and contains one head and a thin, watery fluid. After the cyst has persisted for one year or longer it degenerates, the content becoming purulent, and later calcifying.

Symptoms.—Cysticercosis in swine is rarely recognized clinically. The migration into and irritation of the muscle may cause muscular soreness and disturbed locomotion which, depending upon the extent of the invasion, may be associated with inappetence, unthriftiness, and emaciation.

Treatment.—Prophylaxis consists of preventing contamination of swine food and water with human excrements. No curative treatment is available.

SARCOSPORIDIOSIS

Sarcosporidiosis is a disease of muscular tissue due to a parasite, the Sarcosporidia. This condition is relatively common in swine. Generally speaking, sarcosporidiosis is not considered a disease of much importance in swine. No doubt the encysting of the parasite produces a myositis and should the heart become extensively infested, fatal myocarditis may result.

Etiology.—The Sarcocystis miescheria is the cause of sarcosporidiosis. The exact life cycle of this parasite is unknown.

Lesions.—The cysts are usually so small that they cannot be detected without the use of a microscope. However, an unusual specimen was obtained by York at an abattoir in Chicago in which the cysts could be readily detected as grayish-white ovoid patches. Microscopically, the parasites are found within the muscle sarcolemma. They appear to destroy or displace the muscle substance, the fiber being entirely severed, the sarcolemma alone remaining intact. The sarcocysts contain many round or oval bodies, the sporozoïtes. The cysts undergo degeneration and calcify, but at what age these changes occur has not been determined.

Symptoms.—The disease has not been recognized clinically, but no doubt infestation would interfere with the muscle function.

Treatment.—Therapeutic treatment is not available, and in the absence of a definite knowledge of the life cycle of the parasite, preventive measures are only problematic. General sanitation should be maintained.

TUMORS

An occasional tumor is encountered that has invaded the muscular or osseous tissue of swine. But, generally speaking, tumors of these structures are of little significance.

CHAPTER IX

THE SKIN

Erythema
Freezing
Hemorrhage
Urticaria
Impetigo
Eczema
Dermatitis granulosa
Tumors

Parasites
- Fleas
- Lice
- Mange
  - Sarcoptic
  - Demodectic
- Ticks

Ringworm
Tumors

Diseases of the skin are probably not so common in swine as in other domestic animals. Because of the location of the skin it is subject to a variety of injuries of various kinds, but fortunately swine are not very susceptible to wound infections and therefore cutaneous lesions heal promptly and with little inconvenience to the afflicted animal.

ERYTHEMA

Erthema is a name applied to the condition resulting from congestion of the skin. It is quite common, particularly in swine having little or no pigment in the skin. It is also a common condition in some infectious diseases, such as swine plague and hog cholera.

Etiology.—Simple erythema in swine is most frequently the result of sunshine but may be due to contact with some irritant. In some instances erythema may be caused by ingested chemicals that have a special selective action on the skin or are eliminated by the skin.

Lesions.—Engorgement of the superficial vessels and redness are the only demonstrable lesions.

Symptoms.—Redness, and perhaps pruritus, are the principal symptoms.

Treatment.—Remove the cause, and the disturbance will cease to exist.

Sunburn

Swine having little pigment in the skin are injured by sunlight. In some sections it is not profitable to raise white pigs because of the irritation of the skin by the sun and the production of dermatitis.

Sunburning is a type of dermatitis characterized by erythema, tumefaction, and desquamation of the superficial layers of the epidermis. In long-continued cases the skin becomes thickened, due to the formation of fibrous tissues. Swine affected with dermatitis do not thrive, and they evidence a harsh skin and bristly coat.

Treatment.—The treatment of these cases is simple, as about all that is required is to shield the animals from the direct light of the sun. Should the inflammatory process be well marked, cooling antiseptic solutions may be applied.

FREEZING

Pigs farrowed in midwinter in the northern portion of the temperate zone, where not properly housed, are frequently frozen. The ears and tail are most affected because of the large surface exposure and distal location where the circulation is diminished. In some instances the tissues are destroyed by the low temperature, and slough, while in other cases the ears or tail, or both, are frosted only and an inflammatory reaction is established resulting in an engorgement and tumefaction of the part. Later the skin desquamates and the parts are tender when palpated.

Transportation of market hogs in open stock cars during very cold weather is responsible for the freezing of the surface skin. The skin sometimes evidences the lesions in strips corresponding to the openings between the boards on the car. The lesions are similar to those described in small pigs.

Treatment.—This consists of protection against further freezing and the local application of protectant dressings, as in ordinary wounds.

HEMORRHAGE

Cutaneous hemorrhage in which the extravasate is retained in the skin is relatively common but is practically always associated with specific diseases, seldom occurring as simple cutaneous hemorrhage.

URTICARIA

Urticaria is a skin disease characterized by the formation of pruritic wheals. It is not common in swine and when occurring is usually found in young pigs.

Etiology.—Urticaria is of systemic origin. It is usually associated

with digestive derangement, but may be caused by filth and the irritation caused by lice.

Lesions and Symptoms.—The typical lesions are red, circumscribed blotches that are hot and pruritic. Because of the pruritis the pig rubs the skin and may produce abrasions from which serum and blood may escape. The disease usually terminates in recovery on the second or third day, although in severe cases pustular formation may follow.

Treatment.—Clean the swine and premises, and administer a saline purgative, such as Epsom salt.

IMPETIGO (MEASLES)

Impetigo is a condition in which there is an eruption of papules or pustules. The pustules may rupture soon after eruption or become

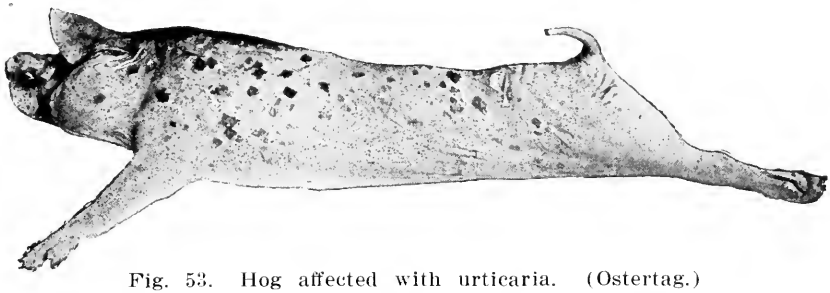

Fig. 53. Hog affected with urticaria. (Ostertag.)

desiccated, forming a crust or scab. This condition is commonly erroneously called measles.

This condition is relatively common in pigs in some sections of the United States, particularly in the southern states. It has been observed in range swine as well as in swine that have been kept in small feed lots. An individual case may be observed but it more commonly assumes the form of an infection and from 5 to 80 per cent of the pigs on a farm or range will become affected. The disease is rarely fatal but is of economic importance because the animals that are affected do not develop properly and persist as small dwarfs or runts regardless of the fact that they may be given an abundance of the best quality of feed.

Etiology.—The specific cause of this condition has not been determined. Various pyogenic micrococci have been isolated from the local lesions, but these micro-organisms may be found upon the skin of normal swine and they may therefore be considered of secondary

importance. Bull has reported the finding of pyogenic micrococci and streptococci and the B. enteritidis from the tissues and blood of affected animals. This disease may exist as a primary condition or it may occur simultaneously with hog cholera, infectious necrotic enteritis and other diseases.

It is possible that parasites, such as lice, fleas, mosquitoes, gnats and flies, may be factors in the causation of this disease. Filaria may also be of some importance in the production of impetigo.

Lesions.—The first evidence of the disease is the appearance of small elevations on the skin, which may be irregularly scattered over the body, head and legs, but are most commonly observed on the belly, behind the shoulders, on the inner side of the thigh and on the under surface of the neck. These elevations may contain a small droplet of pus or appear as typical papules. In either case the superficial epithelium desiccates and may desquamate leaving a denuded surface from which small quantities of serum escape, dry and form scabs. When the superficial epithelium does not desquamate it becomes impregnated with the escaping serum which desiccates and forms a scab. Several elevations may converge forming areas one-half to two-thirds of an inch in diameter. The scabs may cause depilitation and the lesions may destroy follicles so that an affected animal's coat is irregular and flea-bitten in appearance.

Symptoms.—Impetigo is manifested in the beginning by a papular or pustular eruption and later by the accumulation of scabs and more or less depilitation. There is usually more or less pruritus in the early stages of the disease. Affected animals are unthrifty in appearance and become emaciated and do not grow or develop. The local lesions persist for several days; the scabs ultimately slough, leaving a small scar. In some cases the hair follicles that were involved in the lesions are permanently injured and there will be absence of hair.

Treatment.—No satisfactory method of treatment has been found. Various solutions have been used as dipping agents but they have not proved of value. Laxatives may be of some service and it is possible that autogenous bacterins may prove valuable as a curative agent.

ECZEMA

Eczema is an inflammation of the skin characterized by multiform lesions. Though this disease occurs in swine, it is not very prevalent.

Etiology.—Eczema in swine is apparently a disease of filth. Weak, anemic pigs are much more susceptible than strong and otherwise healthy animals. The specific exciting cause is not known.

Lesions and Symptoms.—Typical eczema is characterized by the following lesions, which occur in the order mentioned: erythema and papulovesicular eruption, which may or may not be succeeded by the formation of pustules. The contents of the vesicles and pustules become desiccated and accumulate, thus forming scabs. There is pruritus practically throughout the entire course of the disease. As the disease progresses the skin becomes thickened, leathery, and cracks, the crevices or rhagades extending deeply, more or less blood escaping.

Eczema is differentiated from parasitic dermatitis by the absence of the parasites. It is essentially a chronic disease; there may be repeated attacks. The disease as a rule is not fatal in swine.

Treatment.—Remove all influences that predispose to the condition. Prevent injury from rubbing. Topical applications of soothing agents may be used, but their value is doubtful. See that the animals obtain and digest their food properly. A good, brisk purgative occasionally will be of value.

DERMATITIS GRANULOSA

A granular skin eruption has been identified in swine. The condition occurs in patches on the ears, back, and croup, and is probably infectious.

This condition has responded quickly to treatment with antiseptics.

NECROBACILLOSIS, ACTINOMYCOSIS, TUBERCULOSIS

Necrobacillosis is a very common cutaneous disease in swine. Cutaneous actinomycosis and tuberculosis occur less frequently. These conditions of the skin will receive consideration under the special topics of necrobacillosis, actinomycosis, and tuberculosis.

TUMORS

Cutaneous tumors, excepting papillomas or warts, are not common in swine.

Papillomas are structurally hypertrophied papillas. They may occur on any portion of the skin surface, but are probably more common on the muzzle and on the inner surface of the thigh.

Papillomas or warts are usually harmless and may be removed by surgical procedure. They should be removed in their entirety, either by means of a knife or a pair of scissors.

PIGMENTED MOLE

These are relatively common and in some cases they become malignant, probably as a result of irritation incidental to treatment. These

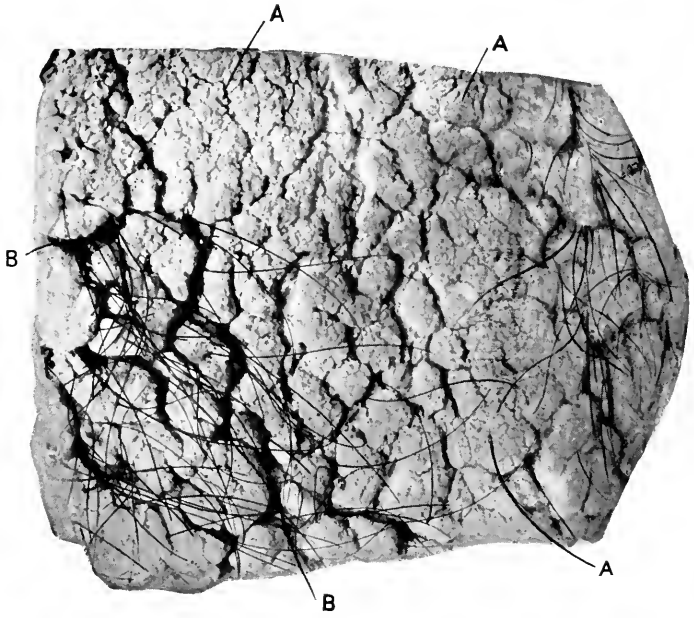

Fig. 54. ELEPHANTIASIS. A, Granular papillomatous, depilitated areas; B, rhagades, or crevices.

moles are sometimes pigmented with melanin, and when interfered with develop into malignant melanosarcomas. Many pigmented papillomas and papillo-fibromas are also encountered in the skin of swine, while multiple fibromas have been observed, they are not at all common. More rarely have primary or even secondary carcinomas and epitheliomas been recorded as cutaneous tumors in swine.

PARASITES

Swine harbor many cutaneous parasites, some of which are exceedingly detrimental to the health of the animals.

Screw Worm

Of the dipterous group one only, the Campsomyia macellaria (screw-worm), requires special mention. In some sections these parasites cause considerable damage and some fatalities. The larvæ only are parasitic, the adult female depositing the ova in wounds or damaged tissue. The ova hatch in from one to ten hours and immediately begin to burrow into the surrounding tissues. The fully developed larvæ are about one-half an inch long and about one-third the diameter of a lead pencil. The damage consists not only of mechanically lacerating the tissues but also of carrying infection

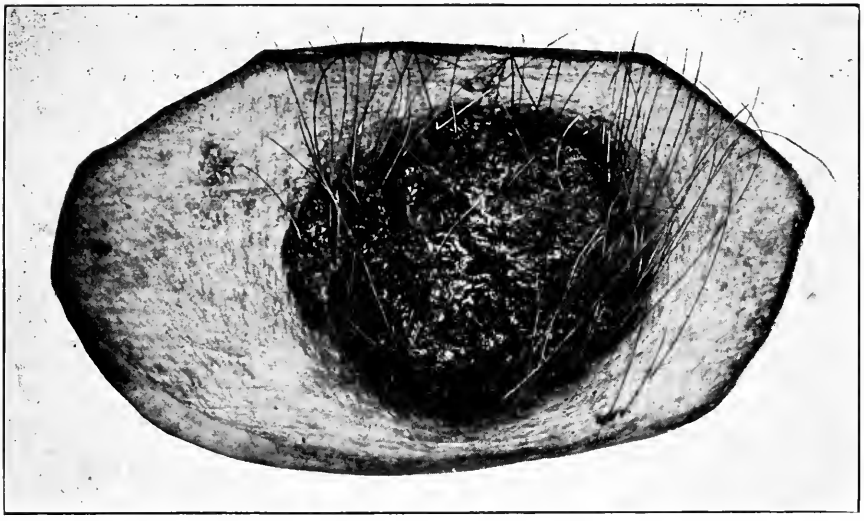

Fig. 55. PIGMENTED MOLE. Showing an ovoid pigmented area, with an irregular nodular surface and containing a few long hairs. These pigmented areas or moles cause little or no inconvenience unless irritated by drugs or surgical interference.

into the surrounding tissues. The larvæ remain in the tissue from four to six days, then drop to the ground, where they undergo the pupal metamorphosis.

The time-honored treatment consists of curetting the wound, thus removing all the larvæ possible. It may be necessary to apply chloroform or some penetrating antiseptic to cause the larvæ in the deeper tissues to migrate to the surface, or at least to move energetically in order that they may be located and removed. The wound should be properly dressed and protected against future infestation. It is

always well to observe the wound on the second day to make certain that all larvæ have been removed. However clinicians report that this line of treatment is wholly ineffective, claiming better results are obtained from the treatment for screw-worm infestation given on page 198.

Flea Infestation

Representatives of the order, Siphonaptera, constantly inhabit hog houses and pens in some sections of the country. These parasites are blood suckers and obtain their nourishment directly from the swine, but do not appear to cause any serious trouble. No doubt they produce some irritation where they pierce the skin, and swine thrive better in their absence. Fleas breed in filth, the ova being deposited in fecal matter or other filth. The larval and pupal stages also take place in filth and in the soil, the entire cycle from adult to adult requiring about one month.

Fleas may be lessened in number and ultimately eradicated from most premises by persistent cleanliness and by dipping the swine in some standard dip every ten days for a period of six weeks.

Lousiness (Phthiriasis)

Phthiriasis, or lousiness, is the most common parasitic disease of swine. The hog louse, Hematopinus suis, is a blood-sucking louse and one of the largest of known lice. The adult ovigerous female cements the ova on the hair behind the ears, in the flank region, and elsewhere. The ova hatch into small lice in from ten days to two weeks. These lice do damage by direct abstraction of blood and by irritation of the skin, which causes more or less pruritus. This makes the swine restless and, not receiving their proper rest, they probably do not do as well as they otherwise would.

It is not a difficult matter to eradicate lice, but their permanent elimination from swine entails continued vigilance. Where large numbers of swine are infested the most economical plan is to put in a dipping vat and dip the hogs every ten days for three or four dippings. In the meantime the sleeping quarters should be cleaned and dipping solution used here as a spray. If there are only a few swine to treat, hand dressing with some standard dip is the most economical method of treating them, or if the swine have a tank or place where they wallow, some dipping solution may be placed therein. The swine thus dip themselves and destroy the lice.

The rubbing post has been used with fair success as a means of holding louse infection in check. One or more posts are set in pens and ropes wound tightly around them for a distance of two feet from the ground. These ropes should be moistened with crude petroleum from time to time. The swine will annoint themselves and destroy most of the lice by rubbing themselves against these posts.

Mange

Mange, or infestation of swine with some Acari or mange parasites,

Fig. 56. Male hog louse. (Farmers' Bull. 1085, Dept. Agri.)

Fig. 57. Female hog louse and egg attached to hair. (Farmers' Bull. 1085, Dept. Agri.)

is not a rare condition in this country, where two forms of mange occur—sarcoptic and demodectic.

Sarcoptic Mange

Sarcoptic mange is enzoötic in certain sections. It is caused by infestation with the Sarcoptes scabiei, var. suis. The life cycle of this parasite is as follows:

The ovigerous female burrows into the skin, forming galleries in which she deposits her eggs, usually about fifteen in number. The ova hatch in from five to ten days into six-legged asexual larvæ which may remain in the galleries or pass out under the scabs, and in two to

three days moult into nymphæ. The nymphæ have four pairs of legs, but they have no sexual organs. In two or three days the nymphæ moult and the sexually matured males and females come forth. The sexually matured parasites mate, and in about three to five days the ovigerous female is found in the gallery in the skin, ovulating. Thus the entire life cycle does not exceed twenty-five days, and under the most favorable conditions may be accomplished in fifteen days. From each ovulation about five males and ten females are produced, and if the reproduction were to go on unhindered for three months, the total

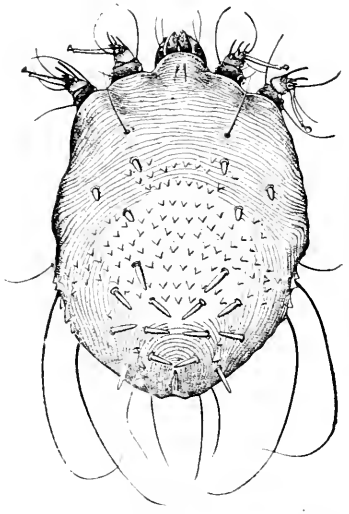

Fig. 58. Sarcoptic mange mite. Female. Magnified 100 times. (Farmers' Bulletin 1085, Dept. Agri.)

reproduction would approximate 1,500,000 parasites. The adults are mere specks, barely visible to the unaided eye.

Swine become infested from infested premises or from infested swine. Premises may remain infested for six months or even longer.

Lesions.—The lesions produced by the Sarcoptes are practically confined to the skin; however, secondary lesions, as emaciation, may arise. The parasite obtains tissue juice by pricking the skin with its stylet. The stylet injury produces erythema, succeeded by the formation of vesicles, which rupture, the vesicular fluid drying and forming a scab beneath which the parasites are found. Scabs are of varying thickness, and accumulate wherever the parasites are found unless the

affected animal rubs them off. Galleries are formed within the skin, and this also adds to the irritation. The accumulated dry scabs break and damage the hair more or less, which falls, leaving the parts affected practically hairless. The irritation causes inflammation, and this results in fibrous proliferation and thickening of the skin. The thickened, leathery skin loses its pliability and becomes fissured or cracked. In long-continued cases the animals become emaciated.

Symptoms.—Intense pruritus, especially around the ears and eyes,

Fig. 59. Case of advanced hog mange showing wrinkled condition of skin. (Farmers' Bull. 1085, Dept. Agri.)

and the finding of papules, vesicles, and scabs are the first evidences of scabies. Later there is depilation and thickening of the skin, with the accompanying rhagades. The disease will probably affect all the swine that have been kept in one lot. The finding of the parasite is positive evidence upon which to base a diagnosis.

Treatment.—Sarcoptic mange may be successfully treated by the use of the lime and sulphur dip or nicotine dip, repeating every ten days for three dippings, provided that the quarters are cleaned and disinfected and the thick scabs are removed so that the dipping solu-

tion may gain access to the parasites. Some old chronic cases do not respond readily, if at all, to treatment because of the thick, wrinkled skin which protects the parasite.

Fig. 60. Advanced hog mange showing pedicle-like scabs. (Farmers' Bull. 1085, Dept. Agri.)

Demodectic Mange

Demodectic or red mange is not so prevalent in swine in America as is sarcoptic mange. Red mange rarely occurs enzoötically.

The cause of red mange is the Demodex folliculorum, var. suis.

This parasite is not visible to the unaided eye. Microscopically, it is found to be similar in shape to an oat grain and has four pairs of short legs. The life cycle of this parasite is practically the same as

Fig. 61. Convenient trough for vaccinating swine.

of the Sarcoptes scabiei, var. suis, except that the ova are deposited in a pustule in the hair follicles and sebaceous glands instead of in intradermal galleries.

Lesions.—The skin of the legs of swine is most frequently affected. The parasite gains entrance to the hair follicles, where it produces inflammation and causes depilation. The inflammatory reaction causes a redness of the skin, hence the name. In a case of long standing the skin is red, thick, wrinkled, cracked, practically hairless, and evolves a peculiar characteristic odor. The disease extends slowly upon the animal body, and it is not uncommon to find only one animal affected in spite of the fact that there are many swine in the same pen.

Fig. 62. Pig showing effect of follicular mange, evidenced by a thickening and wrinkling of the skin. Small pustules and reddening of the skin also characterize this disease.

Positive diagnosis can be made only by identifying the parasite microscopically.

Treatment.—This condition is practically incurable, at least in so far as our present knowledge is concerned. Affected animals should be sent to slaughter, as this condition does not impair the meat for food. If for any reason the animal is to be kept upon the premises, it should be placed in rigid quarantine.

Tick Infestation

Infestation of swine with ticks, particularly the ear ticks (Ornithodorus megnini), has attracted the attention of some southern swine breeders. These ticks locate in the external ear and produce irritation which annoys the infested animals. They may be removed by pouring into the ear some alcohol, dilute antiseptic or bland oil.

Fig. 63. Hog wallow of concrete. (Farmers' Bull. 1085, Dept. Agri.)

Thread Worm Infestation

Cutaneous infestation by Filaria may occur in swine, but it has not been positively identified.

Ringworm Infestation

Rarely does ringworm occur in swine. The condition is caused by a Trichophyton.

Lesions.—The lesions are usually located on the back or the outer surface of the thighs and are seen as isolated, circumscribed, round, red spots with a raised margin which bears small vesicles. The central portion appears normal, except that it is scaly. The trouble gradually

extends in all directions, the raised vesicular margin representing the outside of the lesion. When the lesion becomes very large the center, or original lesion, has apparently recovered. The disease is transmitted by actual contact.

Treatment.—Cleanse the affected parts and apply a five-percent solution of creolin, repeating the treatment on the fourth or fifth day.

CHAPTER X

CIRCULATORY ORGANS

Heart
- Hemorrhage
- Fatty changes
- Dilatation
- Pericarditis
- Endocarditis
- Tumors
- Parasites

Blood-vessels
- Anemia
- Leukemia

Spleen
- Necrosis
- Hypertrophy
- Tumors

Diseases of the circulatory organs may be of common occurrence in swine, but such disturbances are rarely recognized clinically.

Heart

HEMORRHAGE

Hemorrhages of small size are frequently found in the heart muscle. These occur in infectious diseases and are the result of bacterial emboli or injury of the capillaries by chemic substances incidental to infection. They are of significance to the meat inspector and the diagnostician.

Subendocardial hemorrhages are common as a sequel of infectious diseases. They are of diagnostic value and are an indication to the meat inspector of some infectious disease or septic intoxication.

FATTY CHANGES

Fatty changes in the heart muscle occur in practically all swine that have been fattened for market. The fat particles are found between the muscle cells at first, but later the cells become infiltrated with fat. The heart is enlarged, is paler in color, and its density is diminished. No visible symptoms are evident, in the majority of these cases the swine being excessively fat and refusing to move about without urging. No treatment is required unless this condition arises in a breeding animal.

DILATATION

Acute dilatation of the heart has been observed in fat hogs in which sudden death occurred. This condition is probably the result of fatty changes in the myocardium.

PERICARDITIS

Pericarditis, both acute and chronic, fibrinous and purulent, occurs in relation with hog cholera, swine plague, erysipelas, tuberculosis

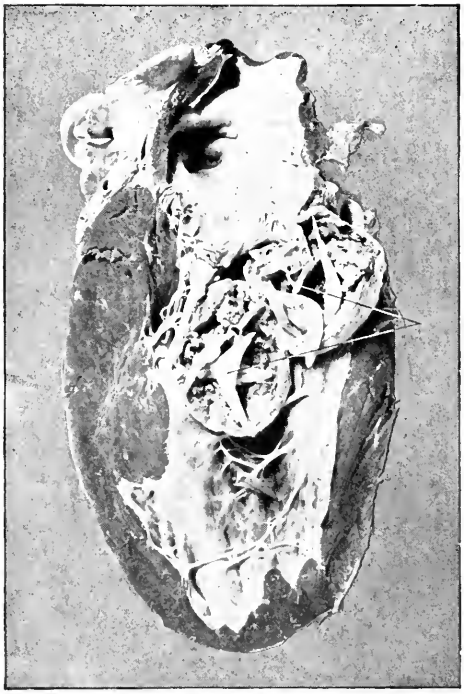

Fig. 64. Hog heart with echinococci. (Ostertag.)

and rheumatism and more rarely as a primary condition. A few cases of traumatic pericarditis have been observed in swine. Cases of pericarditis are rarely diagnosed clinically because of the difficulty of making a careful examination of the heart.

TUMORS

Various tumors have been observed upon the pericardium and also in the myocardium. They are of no clinical significance, but are of

interest to inspectors, as the presence of malignant tumors is considered sufficient evidence for condemnation.

PARASITES

The pericardium rarely harbors the cystic form of the Tænia echinococcus, but Cysticercus cellulosæ is of common occurrence in

Fig. 65. Heart with tuberculous proliferations on the outer surface. (Ostertag.)

the myocardium of swine. The lesion has the same general appearance as it does in voluntary striated muscle. Sarcosporidiosis is not uncommon in the heart muscle of swine.

Acute pericarditis is characterized by hyperemia and hemorrhage.

Endocarditis has been observed by inspectors and in diagnostic autopsies, but the disease is not ordinarily recognized by the clinician.

The lesions found usually consist of vegetative growths or denuded areas upon the endocardium, covering the valves. Either condition is always associated with infection, and it is not difficult to demonstrate bacteria in the lesions and exudation upon the serous lining of the pericardium. The serous surface of the pericardium will have lost its luster and the exudate may adhere to it in shreds. The pericardium becomes thickened in chronic pericarditis, due to the formation of fibrous tissue.

CHRONIC ENDOCARDITIS

(Valvular Insufficiency)

Chronic valvular disease is not uncommon in swine. The valves of the left side of the heart are most frequently affected. Autopsy of such cases usually reveals vegetations on the mitral valves, myocardial hypertrophy, edema of the lungs and in extreme cases ascites. Valvular disease is usually manifested by capricious appetite, dyspnea of varying degree and edema.

Blood-Vessels

Diseases of the blood-vessels of swine have received very little consideration, though a few cases of aneurism have been recorded. Thrombosis has been observed in a very few instances. Inflammatory disturbances have not been reported, or at least the available literature contains no records of such affections. Phlebitis has been observed by serum producers. This condition has occurred in the ear veins, but has not been of sufficient importance to occasion any losses.

Blood

Diseases of the blood of swine have received very limited consideration up to the present time.

ANEMIA

Werner reported his observation of anemia in swine that had been fed watery slop food, while Braasch observed anemia in suckling pigs, but was not successful in identifying the cause. The usual lesions of anemia consist of lack of blood, paleness of the various tissues, emaciation, and a jelly-like consistency of the fat. The affected animals are depressed, weak, and gradually become emaci-

ated. Later edematous swellings occur in the dependent parts of the body.

LEUKEMIA

A few cases of leukemia have been observed in swine on postmortem examination. The exact cause of disease is unknown, but it is probably of an infectious origin.

Lesions.—Porcine leukemic cases thus far observed are of the lymphatic type. The lymph glands become enlarged, due to hyperplasia of the lymphoid tissue, and there are frequently necrotic centers. By scraping the cut surface of a lymph gland a milk-white fluid is obtained. The spleen contains leukemic centers and is enlarged, and the liver may be similarly affected.

Fig. 66. Spleen of hog with a part of the gastrosplenic ligament and omentum. (Ostertag.)

Cases of leukemia have not been studied clinically. The disease is chronic in nature.

Spleen

The spleen is subject to hemorrhages and is engorged in hog cholera and in other septicemic diseases.

NECROSIS

Necrosis of the spleen is of common occurrence in swine that have died as a result of injection of a virus containing the Bacillus necrophorus. These centers vary in size from that of a dime to a fifty-cent piece, are grayish-white in color, and usually have a raised border and depressed center. There may be only one or two of these necrotic foci, or the spleen may be full of them.

HYPERTROPHY

Hypertrophy of the spleen is rather common. The condition occurs in leukemia, tumor formation, and in swine that are fed excessively and in paratyphoid infection.

TUMORS

Sarcomatosis is a relatively common condition in the spleen. The majority of the cases observed were primary, but secondary splenic sarcomas do occur. The tumor is usually multiple, the foci varying in size from mere points up to masses as large as a hen's egg. The centers are white or grayish-white in color, and are rather firm. They are usually circumscribed with a thin, fibrous capsule.

CHAPTER XI

THE NERVOUS SYSTEM

Sunstroke and heat-stroke
Lightning stroke
Epilepsy
Eclampsia
Paralysis
Chorea
Cerebral hyperemia
Parasites

Diseases of the nervous system of the various domesticated animals have not been sufficiently investigated for a good description to be given of them. This is particularly true in regard to diseases of the nervous system in swine.

Malformations of the brain or spinal cord are common in swine. They are observed principally by the breeder and in small pigs, as the majority of these malformations are of such a nature that the affected animal dies soon after birth. Cranial and spinal clefts, with associated hernia of the meninges, brain, or spinal cord, are the most common deformities.

Functional disturbances of the brain, such as delirium, are sometimes observed, but this condition is not common. It is usually the result of organic disease of the brain, although it may be caused by intestinal parasites. The affected swine champ their jaws, grunt, run against the fence, posts, or similar objects, tremble, and may even bite. When the cause is removed the animals make a speedy recovery, although succeeding attacks may occur.

Viciousness is closely associated with delirium. This condition is dependent upon the nature and temperament of the animal and is manifested by a desire to attack man or other animals. Vicious swine bite, and boars use their tusks to inflict injuries, and are sometimes successful in disemboweling their victim. Viciousness is inherited or acquired, and vicious swine should never be used for breeding purposes. Viciousness is acquired by swine that are nervous. Such swine soon become irritable, then vicious, as a result of teasing or brutal treatment. One instance is recalled of a nervous sow that became vicious because the owner's son irritated and tantalized her by catching her small pigs, carrying them squealing, around the pen.

The best method to pursue in cases of viciousness in swine is to prepare them for slaughter and market them as soon as possible.

SUNSTROKE AND HEAT STROKE

It may be possible to differentiate between the sunstroke and heat stroke in man, and possibly also in horses, but such a distinction is scarcely warranted in swine.

Etiology.—Sunstroke if it occurs in swine is caused by the rays of sunlight acting upon the nerve-cells of the brain. Heat stroke, overheat, heat exhaustion or hyperthermia are the result of thermolysis. Swine, especially when in condition for slaughter, are predisposed to overheat because of the excessive accumulations of fat.

Driving swine in droves is occasionally accompanied by cases of heat stroke, and this may also be observed in carload lots in which the swine are crowded and the shipment made in extremely hot weather. The same condition arises in swine that are hauled in wagons, if proper precautions are not taken. Lack of proper shade predisposes the swine to sunstroke and to heat stroke.

Lesions.—The gross lesions that characterize overheat are practically the same as asphyxia and consist of parenchymatous degeneration of all essential structures as liver, kidney, heart and voluntary muscle. The blood is usually dark, and does not coagulate readily and the veins are engorged. The lungs are usually engorged with venous blood. There may be ecchymotic cardiac hemorrhages. Microscopically, the nerve cells are found to contain coagula, and there may be cloudy swelling of all parenchymatous tissues.

Symptoms.—Uncertain gait, dullness, depression, increased respiration, and anxious expression are the principal symptoms observed in the early stages of these conditions. The temperature may be very high. Muscular tremors, falling to the ground, and convulsions are the final symptoms. The course of the disease is short. In some instances the animal succumbs within a few minutes after the onset; in other cases the animal may live for from one to three days, and in rare instances may recover.

Treatment.—Place the animal in a shady spot, give rapidly diffusable stimulants, and apply cool but not cold water over the body, and if possible, use ice packs on the head.

LIGHTNING STROKE

Lighting stroke sometimes occurs in swine, particularly among those in pasture. The lesions of lightning stroke are not well marked.

Burning of the surface and irregular congested streaks may be observed. Tissue hemorrhage may or may not occur. The carcass of an animal dead from lightning stroke putrefies rapidly.

Swine that are struck by lightning may be instantly killed or they may be rendered unconscious or only temporarily stunned. Those that are not killed will show unsteadiness of gait, and they may even be unable to walk. The animals that are not killed instantly usually make a speedy and complete recovery. Little is required in the way of treatment. The affected animals should be made comfortable and, if necessary, stimulants should be given.

EPILEPSY

Epilepsy is a nervous disorder characterized by sudden temporary loss of consciousness, with partial or general convulsions. Some authors doubt the occurrence of true epilepsy in swine; however, cases of a nervous disorder with characteristic symptoms of epilepsy have been observed. It is possible that true epilepsy does not occur in swine, but when these animals are closely confined or when infested with parasites characteristic epileptic attacks do occur. The type of epilepsy that occurs in swine may be properly termed reflex epilepsy.

Etiology.—Epilepsy is a functional disorder and may be the result of a variety of causes. Parasitic infestation of the digestive tract is a common cause of this disorder, particularly in young pigs. Invasion of the brain with echinococcus is sometimes responsible for attacks of epilepsy. Auto-intoxication is probably an important factor in some cases of epilepsy. Cut hair or other concrements are frequently found in the stomach of swine that have had attacks of epilepsy. There is apparently some relationship between the sexual function and epilepsy as attacks sometimes occur in young boars at the age of puberty and in gilts during the estrual period.

Lesions.—The disease is primarily a functional disorder, and there are no lesions that are constant and can be said to be accountable for the seizures of epilepsy.

Symptoms.—The attack may be sudden, especially in young pigs. They may come to the feed trough, eat a few mouthfuls, back up, fall over, lose consciousness and lie kicking and champing their jaws. The affected pig soon gets up, moves about with an uncertain gait, has staring eyes but soon regains consciousness and although there may be some indication of weakness is otherwise normal. There may

also be defecation, urination, and discharge of semen. The seizures are of short duration, rarely exceeding five minutes. The attacks may occur in rapid succession, or considerable time may elapse between attacks.

Treatment.—Treatment is of no practical value, except to remove the cause when known. The affected animals should be destroyed if the seizures are frequent and severe, or in mild cases the animals should be prepared for market. They should never be used for breeding, as the condition apparently is hereditary.

ECLAMPSIA

Two conditions may be conveniently discussed under this caption, viz., dentition eclampsia and puerperal eclampsia.

Dentition eclampsia.—This condition is relatively common in pigs. It is no doubt frequently confused with epilepsy. The usual cause of dentition eclampsia is irritation due to the eruption of teeth. The symptoms evidenced consist of muscular twitching, champing of the jaws, rolling of the eyes and convulsions, but the affected animals retain consciousness. These cases may be relieved by placing the affected pig in warm water, and the attacks may be prevented by lancing the gums.

Puerperal eclampsia.—This disease is sometimes observed in sows at the time of, or soon after parturition. The condition may be caused by auto-intoxication or uremic poisoning. There are no definite lesions of puerperal eclampsia. The symptoms of this condition consist of muscular tremors, tonic or clonic muscular spasms and convulsions, but the affected animals are apparently conscious. When this condition occurs during parturition it may be overcome by effecting delivery promptly. Chloral hydrate in half ounce doses injected into the rectum is serviceable in overcoming the spasms. Fluid extract of veratrum viride in 15-drop doses injected intramuscularly is claimed by some practitioners to give splendid results.

PARALYSIS IN PIGS

Paralysis in pigs is a relatively common condition and is responsible for extensive losses. It has been more prevalent, or at least more cases have been reported, in the last ten years than it was previous to that time. This condition should not be confused with rickets, eclampsia, or cases of lameness. Paralysis occurs in all kinds of swine regardless of breed or their physical condition. One type

of this disease, according to Wehrbein, occurs only in pigs up to six months of age and usually affects more than one pig in the same litter.

Etiology.—This condition does not appear to be the result of any one specific causative agent. In some instances the disease on a farm or community occurs in pigs from one particular boar. Inbreeding may be a factor in the causation of pig paralysis. Tuberculosis of the vertebral column may produce symptoms that cannot be readily differentiated from paralysis. Parasitic invasion of voluntary muscular tissue, spinal cord or nerves may produce paralysis. Malnutrition may also be an important factor in paralysis. The disease is not infectious, or at least experiments in which blood and nerve tissue were injected into susceptible pigs proved negative. The disease has not been transmitted by contact of affected and susceptible pigs, which is further evidence of its non-infectiousness. The causative agent exerts an influence on the motor nerves.

Lesions.—The lesions found in those cases in which there is a tubercular infection are characteristic of tuberculosis. In the cases of paralysis due to tubercular infection there is usually involvement of the vertebra, resulting in a rarefying osteitis and diminishing of the lumen of the neural canal and usually pressure upon the spinal nerves and spinal cord. In typical cases of pig paralysis there are no gross lesions. Microscopically the motor nerve-fibers are found to be involved. The fibers degenerate and there is a fibrous proliferation between the nerve-fibers. The extent of the degeneration and fibrous proliferation varies in different cases and also in different stages of the disease. These changes are designated as polyneuritis parenchymatosa.

Symptoms.—The first symptoms evidenced in some cases consist of disturbances of locomotion. The affected animal may appear stiff and knuckle over and it will weave or wabble and may fall to the ground. In other instances the onset of the disease is rapid, the first indication being paralysis and inability to arise. The affected animals are unable to stand even though they be raised to their feet. The paralyzed pig will assume the decubital position with little concern and apparently without discomfort. They will have a normal appetite and may even develop, though usually less rapid than normal pigs if feed and drink is provided. Their temperature remains normal unless some complication arises. Defecation and urination are usually normal.

The paralysis usually involves the hind legs, though in some instances the front legs may be affected. An occasional case has been observed in which both the front and hind legs were simultaneously affected. After the disease has progressed for some time the muscles of the affected portions become tense and hard. Complications due to the constant decubitus usually develop in the course of time and the affected animal dies.

Treatment.—Paralysis due to alterations in the motor nerves is apparently incurable. Inbreeding and inheritance are factors in the cause of paralysis, and the condition may be prevented by outcrossing and eliminating all breeding animals in which a noticeable percentage develop the disease. Medicaments excepting general tonics or laxatives as indicated are apparently of little or no value. If the affected swine are in good condition it is economy to slaughter them before complications arise, as the paralysis does not damage the meat.

CHOREA

Chorea is a neurotic condition characterized by rapid contractions of muscles or groups of muscles.

Etiology.—In many instances chorea appears to be purely functional. Some have attributed it to thrombosis; toxic substances may be a factor in producing it, and in some cases malnutrition predisposes and possibly excites the condition.

No constant tissue change has been identified with chorea.

Symptoms.—Twitching of muscles or group of muscles more or less continuously except during sleep characterizes chorea. The disease may be outgrown in the course of one or two months, or it may become chronic.

Treatment.—Various drugs have been recommended to relieve this condition, but the best plan is to destroy pigs that have aggravated cases, and to fatten and market those having mild attacks.

CEREBRAL HYPEREMIA

Hyperemia no doubt occurs in the brain and meninges of swine, but such cases have received meager clinical investigation. A few cases of purulent cerebritis, or staggers, have been observed. Some of these cases were caused by wormeaten, moldy corn, or at least no new cases appeared after changing the feed. The cerebral tissue was affected and the lesion consisted of a liquefying necrosis, the necrotic area usually occurring in relation to the lateral ventricle and being

unilateral in the cases investigated. The liquefied necrotic tissue was grayish red in color and usually represented an area about the size of an English walnut. The affected swine were generally dull in the beginning, but in one case observed the animal was excitable and delirious. Swine affected with cerebral hyperemia usually evidence an unsteady gait and may fall to the ground and show symptoms of convulsions. One case was observed that turned in a circle, jumped up from the ground, and performed other antics.

Treatment.—Treatment is of little value after the brain substance has become necrotic. In the very early stages drastic purgatives may be of value, particularly if the cause lay in the provender.

PARASITES

Rarely does the Cysticercus cellulosæ develop in the brain of swine. The cyst does not develop as readily in the brain as in a muscle, and it is the exception to find a matured cyst in the nervous tissue. The symptoms produced will depend upon the location of the cyst in the brain.

CHAPTER XII

INFECTIOUS DISEASES

Hog cholera
Swine plague
Infectious necrotic enteritis
Necrobacillosis
Paratyphoid infection
Salmonellosis
Malignant edema
Anthrax
Tuberculosis
Swine erysipelas
Rabies
Foot-and-mouth disease
Tetanus

Hog Cholera

Hog cholera is a specific septicemic disease of swine characterized by parenchymatous degeneration and more or less hyperemia and hemorrhages of various tissues of the body. It is infectious and contagious.

Geographical distribution.—The first indentified outbreak of hog cholera in the United States occurred in Ohio in 1833. From this original center it has spread widely and now prevails more or less continuously in very state of the Union as well as in the surrounding countries, including the island possessions of the United States. The disease was positively recognized in England in 1826, and it still prevails there. In 1896 approximately one-third of the swine population of England died of cholera. The disease was introduced into Denmark in 1887, and spread into Sweden the same year. It also appeared in France in 1887. Hog cholera, or a very similar disease, appeared in Germany in 1866, Prussia, Austria, and Hungary were invaded in 1895. From all reports, it is apparent that hog cholera prevails in practically every country in which swine are maintained.

Hog cholera was first investigated systematically in America in 1885, under the directions of Salmon. The disease was thought, and apparently proved at that time, to be due to a short, rod-shaped bacteria.

De Schweinitz and Dorset further investigated the disease in 1903, and the Bureau of Animal Industry have continued their investigations up to the present time.

Extent.—Information obtained from various sources indicates that hog cholera has been prevalent in America for the past fifty years.

PLATE I.

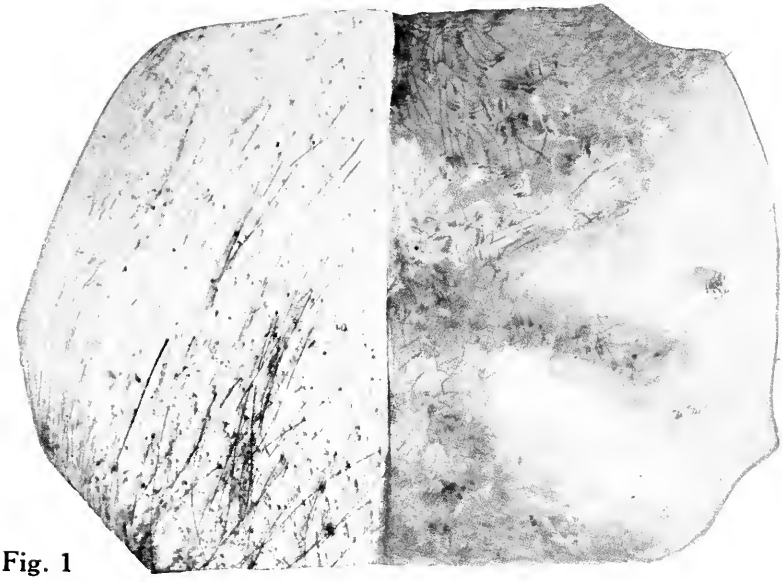

Fig. 1

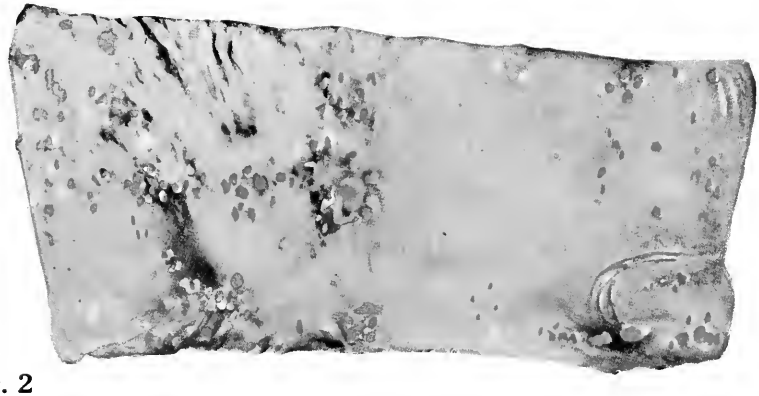

Fig. 2

FIG. 1. Normal skin and skin showing red blotches characteristic of hog cholera.

FIG. 2. Serous surface of intestine, showing sharply outlined petechial hemorrhages, due to hog cholera.

The average annual loss in the United States for the past four decades probably exceeds $30,000,000 annually, and in 1897 the losses due to this disease alone approximated $100,000,000. During the years 1912-13, a severe epizootic of hog cholera extended throughout the principal hog-raising section of the United States, the loss being excessive and for the country at large amounting to over $100,000,000 each year. In 1913 there were 61,178,000 swine in the United States, of which ten to fifteen per cent died of cholera. The losses from

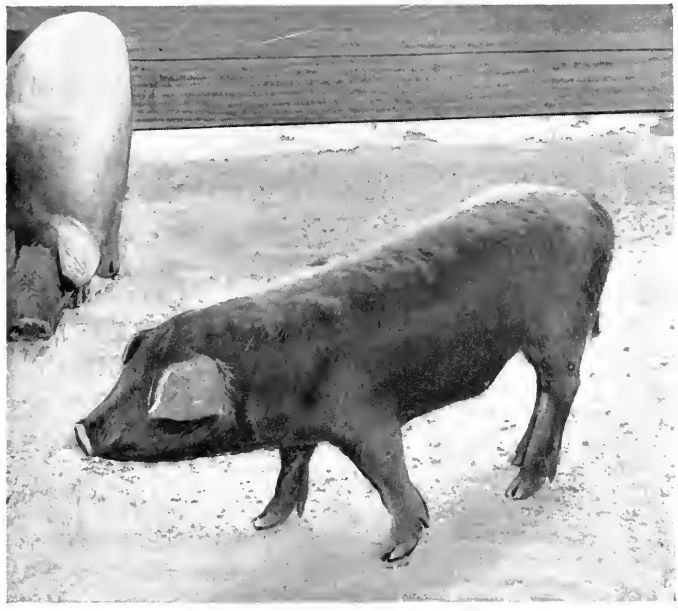

Fig. 67. Hog cholera (Early Stage).

hog cholera in 1912 in Iowa, Nebraska, Kansas, and Missouri exceeded 3,000,000 hogs valued at $30,000,000. The losses in Iowa alone for the years 1911-14 exceeded $10,000,000 annually.

The mortality from hog cholera in the United States in 1914 was approximately ten per cent, but was reduced to less than four per cent in 1919 by the combined efforts of the Bureau of Animal Industry, various state live stock sanitary officials and veterinary practitioners.

Hog cholera is no doubt the most surely fatal disease of swine in

America, and at this time it is the most important disease economically in the United States.

Etiology.—The cause of hog cholera is attributed to a filtrable virus. The relation of a filtrable virus to hog cholera was first recognized by De Schweinitz and Dorset in 1904, and similar investigations by Boxymeyer of Michigan were also concluded in 1904. Other investigators have verified the findings of De Schweinitz and Dorset. The virus of hog cholera occurs in the blood and therefore in prac-

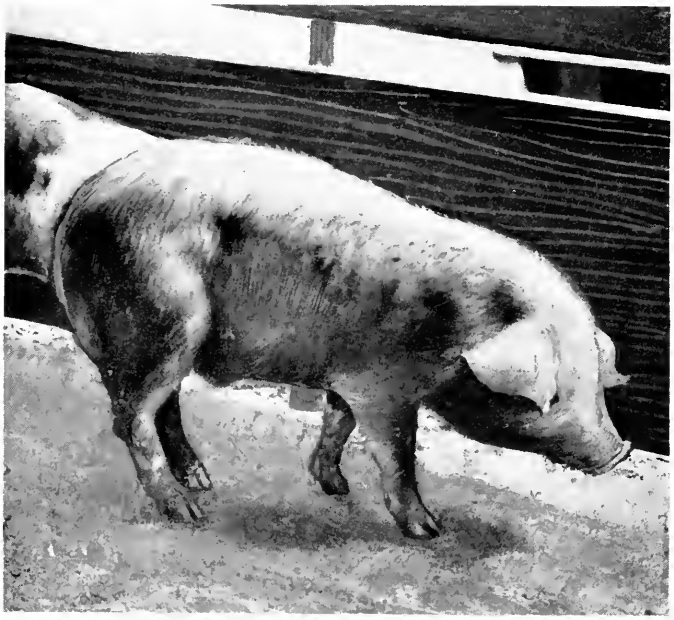

Fig. 68. Acute hog cholera (Advanced Stage).

tically all the tissues of the body of an infected swine. One to two cubic centimeters of filtered blood serum from swine affected with hog cholera will produce typical symptoms of this disease when injected subcutaneously, intramuscularly, intraperitoneally, or intravenously into a healthy, susceptible pig. The symptoms become evident in from five to seven days after the inoculation.

Recently it has been reported by some investigators that the filtrable virus of hog cholera has been successfully cultivated artifically and it has been further indicated that the cultivation of it may become

practicable for the production of hyperimmunizing virus in the near future.

Hog cholera virus is ultramicroscopic and passes through por-

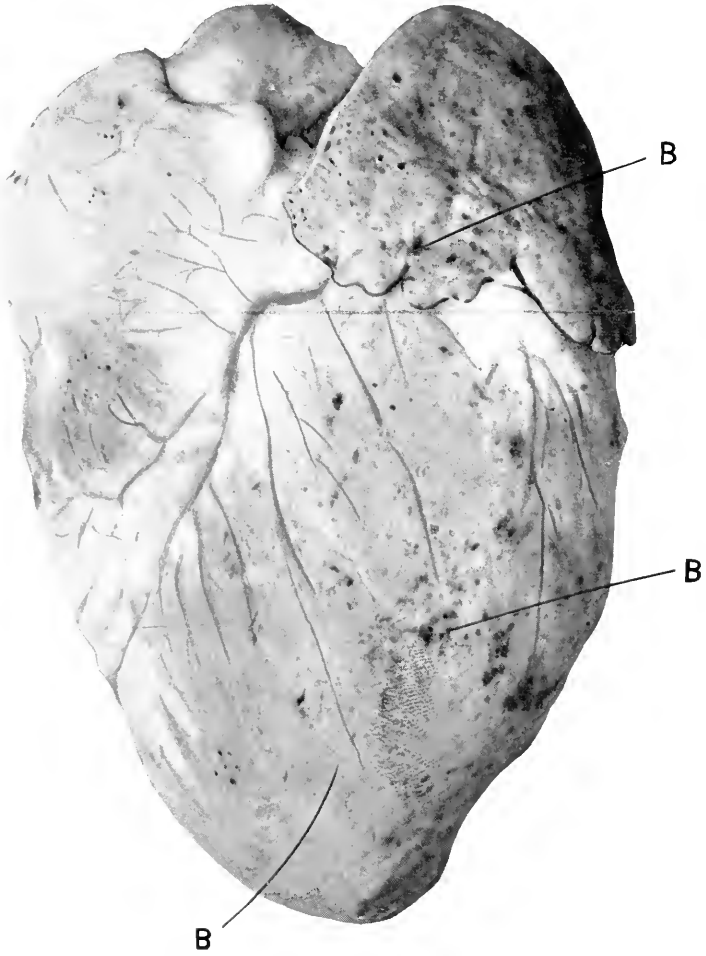

Fig. 69. Heart showing tissue hemorrhages due to hog cholera. B, Hyperemic areas.

celain filters. The virus retains its virulence in fluids at room temperature for from two to three months, but is destroyed by heating to seventy degrees Centigrade for one hour. When dried it becomes more resistant to the influence of high temperature. At the

temperature of an ice box the virulence of the virus is retained for many months. It is very resistant to dilute solutions of phenol, corrosive sublimate, and chinosol. The length of time the virus may remain virulent on infected premises has not yet been determined, but it easily survives a single winter. Certain bacteria including one spirochete may be factors in predisposing swine to the filtrable virus. These various microbian agents are also responsible for complications of hog cholera.

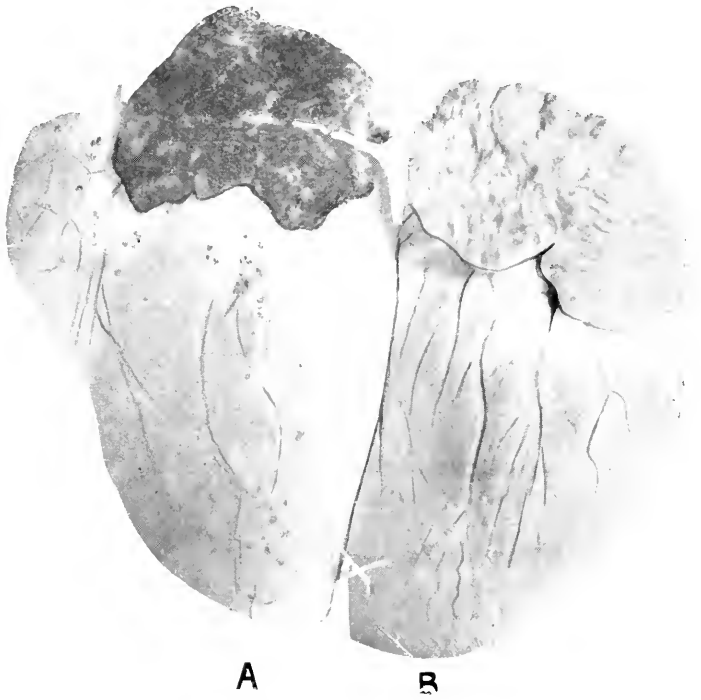

Fig. 70. Hearts. A, showing acute inflammation of the auricle and hyperemic areas in the ventricle, a common condition in hog cholera; B, normal.

The Bacillus suipestifer is no doubt a factor in the production of secondary lesions and some of the complications of hog cholera.

Bacillus suisepticus is frequently demonstrable in the carcasses of swine that have died of hog cholera. This organism is the causative agent of swine plague, and will receive proper consideration in the discussion of that disease. Suffice to say, it is frequently an as-

PLATE II.

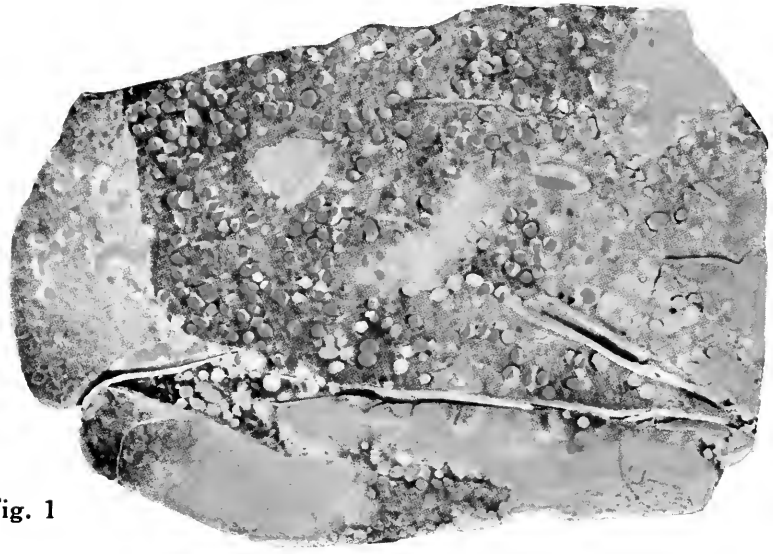

Fig. 1

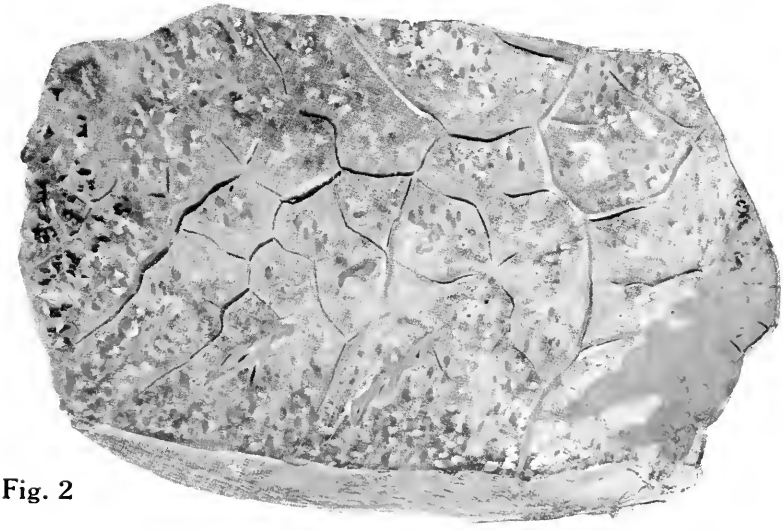

Fig. 2

FIG. 1. Thrombosis of the liver, showing red and white thrombi and thrombi in which decolorization is just taking place.

FIG. 2. Lung showing hemorrhagic areas due to hog cholera.

sociated infection with the filtrable virus, the disease resulting being a mixed infection of hog cholera and swine plague.

Spirochæta suis has been investigated by King and Hoffman. Their experiments indicate that this micro-organism is of constant occurrence in swine affected with hog cholera and further that they could be demonstrated in intestinal lesions in swine in which pure cultures had been used to induce disease.

From the foregoing it will be noted that there has been some contention as to the specific cause of hog cholera.

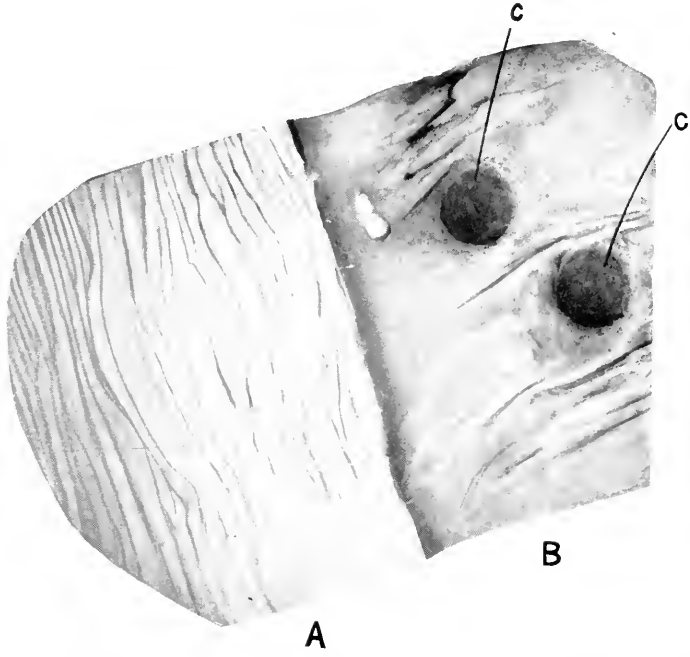

Fig. 71. Mucous membrane of the intestine. A, normal; B, showing effect of chronic inflammation due to hog cholera; C, typical hog cholera ulcers.

Predisposing causes.—The various microbian agents aforementioned are important factors in predisposing swine to the filtrable virus. Many cases have been observed, particularly in stocker swine that have been immunized against hog cholera in public markets, of so-called "serum breaks" in which the symptoms and autopsy findings indicated that hog cholera was a factor in causing the death of what were thought to be cholera immune swine. These accidents

are apparently due to a primary infection with either the B. suipestifer, B. suisepticus, B. coli communis, enteritidis and possibly some other microbian agents separately or in various combinations, thus diminishing the resistance of the swine and the virus used in the simultaneous immunization, which under normal conditions would be harmless, actually producing fatal hog cholera. Similar conditions have arisen when swine affected with infectious necrotic enteritis or swine plague have been simultaneously immunized on farms.

Other predisposing causes of hog cholera are: Age: young animals generally speaking are more subject to hog cholera than mature swine. Sex: excepting mature boars, either sex or barrows are equally susceptible to hog cholera. Old boars may not become affected on farms where practically all other swine die of hog cholera. Breed: all breeds of swine are equally subject to hog cholera. The mule foot hog has been claimed to be relatively immune to hog cholera but these claims are not justifiable. Pure-bred and cross-bred swine as well as scrubs and razor backs, all contract cholera. Season: Cholera prevails throughout the year, although it may be more prevalent in the spring and fall, probably because in those seasons the pigs are at the most susceptible age. Condition of pens: Swine maintained in filthy pens are not so resistant to hog cholera, other things equal, as are swine kept in clean sanitary quarters. Water and feed: Swine are more likely to be healthy if supplied clean wholesome water and feed than if required to drink stagnant filthy water and consume musty or spoiled foods and, therefore, more resistant not only to hog cholera but also other diseases. Parasites: Parasites deplete the body and therefore swine infested with parasites are more susceptible to hog cholera than swine that are free or relatively free, from parasites. Effect of previous disease: Pig scour, navel ill, necrotic stomatitis and other diseases deplete the body and render swine more subject to the action of the filtrable virus.

Sources of infection.—The original source of the virus of hog cholera like the origin of other viruses and pathogenic agents, is unknown. The following are the principal present sources of the filtrable virus of hog cholera: Infected swine, the nasal, ocular and fecal discharges and the urine from infected swine, the carcasses of swine dead of cholera, garbage containing scraps of pork, virus used in simultaneous immunization; food, water, vehicles of transportation, stockyards, and other substances or objects that are contaminated with discharges of infected swine, or the tissues, juices or

products of the carcasses of swine that were infected with the filtrable virus when killed or in which death resulted from cholera.

From the foregoing the ease with which infection is transmitted may readily be comprehended. The virus is transmitted from an infected swine on non-infected premises to other swine, or to soil, food, water, bedding, and general surroundings, thus practically insuring infection of exposed swine on the same premises and other premises as well. Serious outbreaks of cholera are sometimes traceable to the introduction of a new boar, or other animal, that is infected.

If the carcass of a swine dead of cholera is permitted to remain

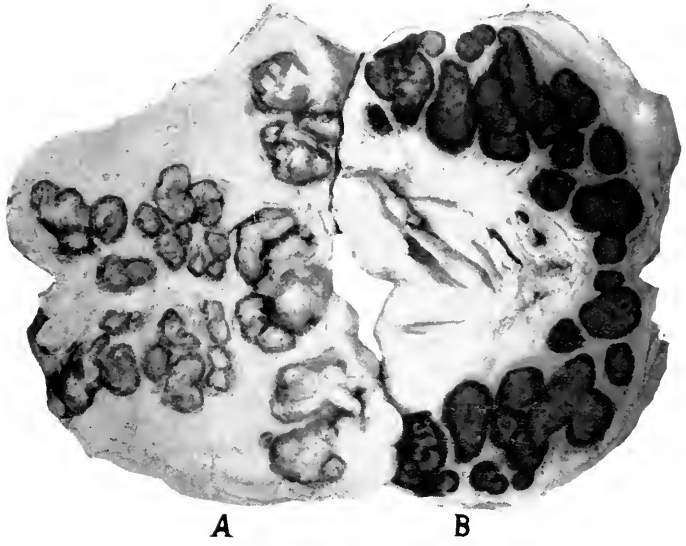

Fig. 72. Lymph-Nodes. A, normal; b, hyperemic due to hog cholera.

in the hog lot, other swine will become infected by eating the flesh, and the soil and surroundings will be contaminated with the virus. Some men have shown their faith in the protection of swine against cholera with serum by putting the carcass of a swine dead of cholera in their pens and thus infecting their premises.

From the lack of care in the use of virus in producing a permanent immunity there is little doubt but that farms have become infected. Food hauled in wagons or other vehicles that have been previously used in transporting cholera-infected swine may become

contaminated and infect healthy, susceptible swine and thus produce hog cholera. Water, too, is frequently the source of infection. This is especially noticeable in the spread of hog cholera in sections of country in which there are many small streams. Such enzootics usually follow the streams. The contamination of surface water is due to the discharges, and even to the carcasses of cholera-infected hogs being washed by rain into the small streams. Many hog raisers have fenced and made pastures of low lands with small streams of water, thus favoring the introduction of infection into their herds.

The shipment of cholera infected hogs to market centers has been of common occurrence, althought there is a federal law prohibiting the shipment of swine affected with an infectious disease. By such shipments stockyards, stock cars and the railroad right of way become contaminated with discharges of cholera-infected swine, and the chances are that some of the discharges contain the virus of hog cholera in a sufficiently virulent form to produce cholera in healthy, susceptible swine. By this means cholera is, no doubt, frequently transported hundreds of miles, and new centers of infection produced.

Federal regulations require the cleaning and disinfecting of cars that are known to have been used to transport cholera-infected hogs to market. This regulation diminishes the spread of infection, but in some shipments the disease is not identified until the hogs are slaughtered, and in many instances the cars in such shipments are not located and are consequently not cleaned and disinfected. By the practice of shipping cholera hogs to market, practically all public stockyards become infected and therefore become a source of danger in the community. The cholera infected swine are hauled or driven from the farm to the railroad station along or over the public road, which thus becomes a source of infection. The virus may adhere to the feet of horses, to the wheels of wagons or other vehicles, and be transported to farms where infection had not before been present.

The possibility of virus carriers of hog-cholera infection must be admitted, although no definite cases have been identified. It is generally conceded that swine immunized simultaneously do not eliminate the virus unless they become visibly sick with cholera and therefore there is always a possibility of establishing infected centers by simultaneous immunization.

Dogs, crows, buzzards, and pigeons are scavengers, and are important factors in the dissemination of infection. Neighbors visiting

back and forth and exchanging labor are prolific means of carrying infection from place to place. Careless veterinarians have in some instances apparently been responsible for the transmission of hog cholera from infected to non-infected premises.

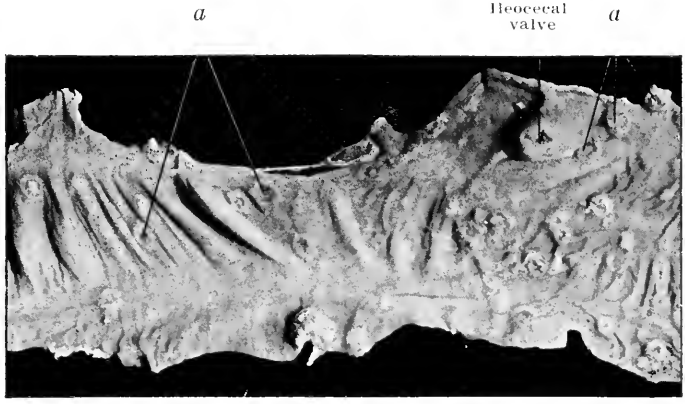

Fig. 73. Large intestine of hog showing small lentil-sized ulcers, a condition frequently associated with hog cholera. (Ostertag.)

The possibility of insect transmission of the filtrable virus should not be overlooked. According to experiments conducted by the

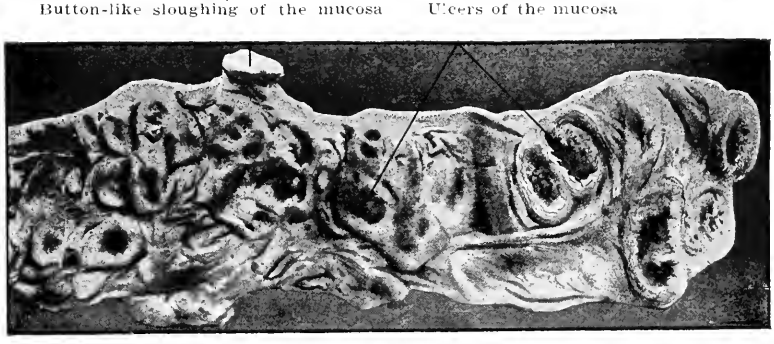

Fig. 74. Large intestine of hog showing extensive alterations, a condition frequently associated with cholera. (Ostertag.)

Bureau of Animal Industry and reported by Dorset, hog cholera was transmitted by house flies that had consumed the nasal or ocular discharges of cholera infected swine and were then transferred to

healthy susceptible swine where they were permitted to walk and feed upon their eyes.

Manner of infection.—Hog cholera may be transmitted by direct or indirect infection. Direct infection may be affected by the actual contact of a healthy, susceptible swine with one affected with cholera. Direct infection may also occur in utero, the pigs becoming infected before birth. This statement may be questioned by some, but the fact that pregnant sows abort when they become affected with hog cholera is common knowledge among swine breeders. It has also been observed that abortion is of frequent occurrence in pregnant sows that are simultaneously immunized. The transmission of the virus from the sow to the pig in utero would not seem difficult when it is remembered that this virus readily passes through porcelain filters.

Indirect infection also is of common occurrence in hog cholera. This is accomplished by the infection being introduced on food stuff, in water, in the inspired air, or on foreign bodies, such as splinters or stubble. Indirect infection is infection that occurs when new centers are established without the introduction of a diseased animal.

Susceptibility.—Young swine are apparently most susceptible to cholera immediately after weaning. However, swine of all ages may become affected. Thus sucking pigs or old brood sows or boars may contract cholera and die of its effects.

Channels of entrance of the infection.—The virus of hog cholera most frequently gains entrance to the body of the swine by way of the digestive tub, upon contaminated food or water, or in various substances that swine are likely to chew or ingest. Infection may also be introduced through the respiratory tract, but infection by this avenue of entrance is not common. The virus may be introduced through the skin by means of barbs, awns, splinters, or similar objects, but this avenue of entrance is not common in natural infection.

In the production of a permanent immunity by the use of the virus and serum, the virus is introduced through the skin by a hypodermic syringe. Injection for the purpose of hyperimmunizing, in the production of anti-hog cholera serum, is done intravenously in an ear vein. Infection may be successfully accomplished by intraperitoneal or intramuscular injections of the virus, but natural infection rarely occurs in this way.

Period of incubation.—The period of incubation after natural infection is variable, depending upon the virulence of the virus and the

resistance of the infected swine. In most instances there will be a rise of temperature from the fifth to the seventh day, and the animals will be visibly sick by the tenth day after infection. The period of incubation in inoculation experiments varies from four to seven days.

Lesions.—Certain lesions have been described by various authors, investigators and practitioners as characteristic of hog cholera, but it has not been definitely determined whether these lesions were due to the filtrable virus or the result of some associated pathogenic agent.

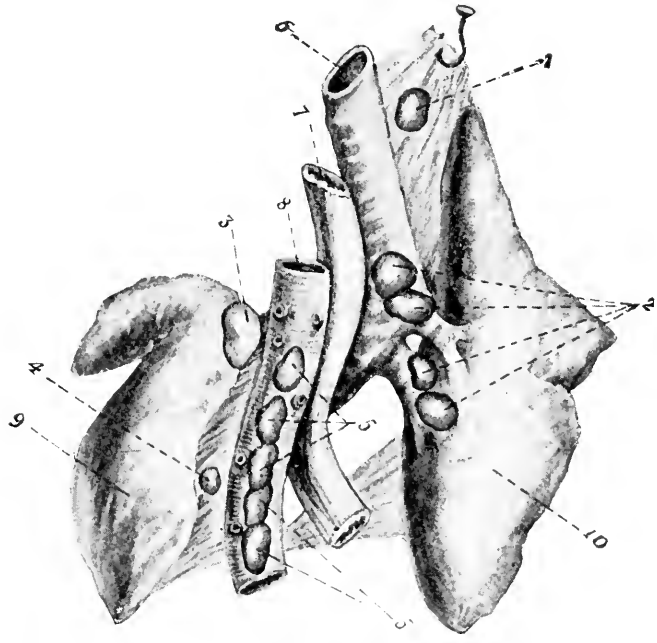

Fig. 75. Lungs of hog showing attached lymph-glands. 1, Lymph-glands on pleura adjacent to pericardial sac; 2, right anterior and posterior; bronchial lymph-glands; 3, left bronchial lymph-gland; 4, lymph-gland attached to mediastinal pleura between aorta and left pulmonary lobe; 5, lymph-glands on superior surface of aorta peculiar to hogs and taking the place of posterior mediastinal chain of glands in bovines. (From Aureggio's "Album Guide.")

It is possible that hog cholera due to the filtrable virus is a lesionless disease in so far as gross lesions are concerned, excepting those changes that occur as a result of a high antemortem temperature. In many cases carefully autopsied, of the first swine that died of the very acute type of cholera, the only lesions found consisted of paren-

ehymatous degeneration or cloudy swelling of the essential organs. Hog cholera, at least when rapidly fatal, is essentially a septicemia, and partakes of the nature of an acute malady. No doubt there are instances when the virulence of the filtrable virus has been diminished or the resistance of the infected animals has been increased and the disease would be prolonged and probably not very fatal unless complications arose.

In the cases of very acute and rapidly fatal cholera the only constant lesion consists of cloudy swelling of parenchymatous tissues. In

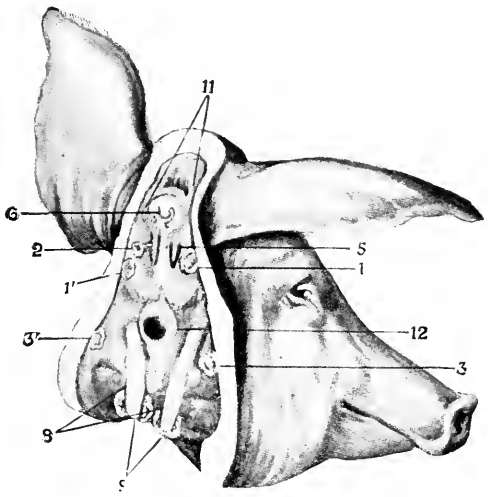

Fig. 76. Head of hog showing lymph-glands. 1.1'. Parotid lymph-glands; 2, postpharyngeal or retropharyngeal lymph-glands; 3.3', superior cervical lymph-glands; 8, submaxillary salivary lymph-glands on each side of the salivary glands in the intermaxillary space. (From Aureggio's "Album Guide".)

addition the following lesions may be found in the cases of the usual type of hog cholera:

Skin.—The skin may be hyperemic, and there may be subcutaneous hemorrhages. The blood vascular skin lesions are most marked on the soft skin on the under surface of the belly and the inner sides of the thighs and forearms. The hemorrhages may be petechial or they may be ecchymotic. When lesions of the skin occur they are scarlet red in color.

Lymph-glands.—The lesions of these glands are not confined to any one gland or group of glands, but may occur in the cervical glands

PLATE III.

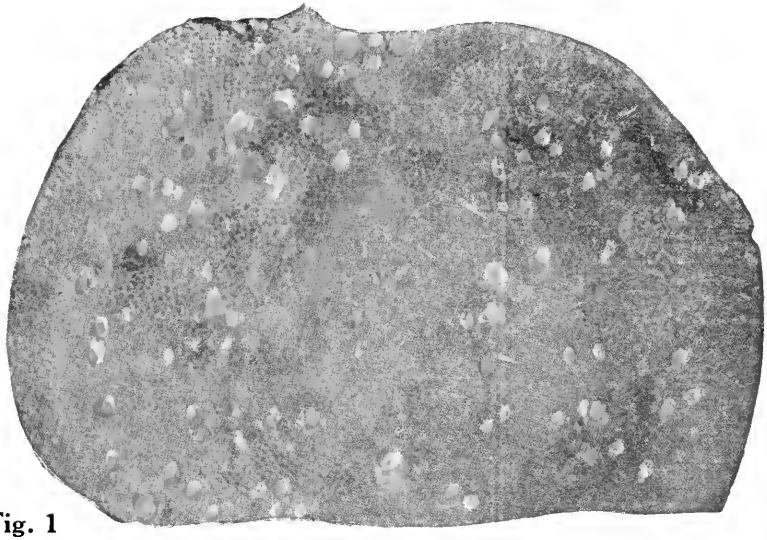

Fig. 1

Fig. 2

FIG. 1. A typical tuberculous liver.

FIG. 2. Vertebrae showing tuberculous bone lesions.

only in one case, in the mesenteric in another case, and may be found in two or more groups of glands or practically all glands in other cases. The changes in the lymph-glands consist of tumefaction, hyperemia and hemorrhage. In some cases there is evidence only of tumefaction and hyperemia; in others there will be tumefaction, hyperemia and hemorrhage. The color of the affected lymph-glands varies from a scarlet red to almost black. In some cases there is a distinct hemorrhage just beneath the gland capsule. The affected glands are usually less dense than the normal.

Digestive tube.—There may be hyperemia and hemorrhage in the mucous membrane, submucosa and subserosa of any portion of the digestive tract. Pharyngeal submucous hemorrhages, petechial or ecchymotic, are relatively common. There may be a general hyperemia of the mucosa of the stomach and small intestines, but it is less common in the mucous membrane of the large intestine. Petechial or ecchymotic hemorrhages are relatively common in the mucosa of the small intestine. Subserous petechial hemorrhages of the stomach, small and large intestine are of frequent occurrence and in some cases the hemorrhages may be ecchymotic.

Spleen.—The spleen may or may not be tumefied due to accumulation of an excessive quantity of blood, and consequently it will be darker in color. There may be hemorrhages of varying size, particularly near the hilus.

Respiratory organs.—Submucous petechial hemorrhages of the epiglottis are relatively common and by some considered characteristic. There may be petechial hemorrhages beneath the tracheal mucous membrane. Petechial hemorrhages may be very prevalent throughout the lung tissue or they may be few in number. Lung hemorrhages are quite constant although cases are observed in which it is not possible to find these lesions. Pneumonia of the croupous type may occur in the cephalic or cardiac lobes.

Heart.—Subendocardial petechial or ecchymotic hemorrhages and subpericardial petchial hemorrhages are common lesions.

Kidney.—Petechial hemorrhages may or may not occur in the kidney. The petechial hemorrhages that occur in cases of hog cholera are relatively small and sharply circumscribed.

Bladder.—The bladder frequently contains petechial hemorrhages which are according to some investigators pathognomonic of hog cholera.

Bones.—The lesions in bones occur in the red marrow and consist

of hemorrhages and change in color. This lesion is particularly noticeable in the red marrow of flat bones, such as the ribs. The affected bones may be practically black because of the hemorrhagic extravasate.

From the foregoing description it will be noted that the lesions of the ordinary cases of hog cholera consist of parenchymatous degeneration of all parenchymatous tissue and there may be subcutaneous, subserous and submucous hyperemia and hemorrhage, tumefaction, hyperemia and hemorrhage of lymph-glands and spleen, all of which are the general lesions characterizing the various septicemic diseases.

Uncomplicated cholera does occur, but is probably the exception and the lesions of hog cholera when associated with other diseases are difficult to recognize.

Symptoms.—Hog cholera is essentially an acute disease. In the beginning of an outbreak of hog cholera the first animals affected die so quickly that the finding of one or more dead hogs is the first evidence of the presence of disease. The first symptom in the usual outbreaks of hog cholera is rise of temperature. The febrile condition in the beginning does not cause any visible manifestation and is ascertained only by means of a thermometer. Thus an infected herd of swine may in the early stages of the disease be carefully inspected and passed as healthy unless temperatures are taken. Some practitioners encounter serious difficulties in the immunization of swine because they do not take temperatures and ascertain the condition of the swine that they are immunizing. The temperature in swine affected with cholera varies from 104 to 108° F.

Soon after the rise of temperature the affected animals are inclined to isolate themselves and stand with their backs arched and heads down, or they may crawl under the bedding. In the beginning the appetite is impaired; later the animals refuse all food. Vomiting is a common symptom in the early stages of the disease. There is usually constipation in the beginning, but this is succeeded by diarrhea. The fecal discharges are frequently admixed with blood. There is usually a purulent conjunctivitis; the discharges accumulate on the eyelashes and frequently cause adhesion of the eyelids. There may be a limited mucopurulent discharge from the nose. In the less acute cases erythema of the skin may occur on the second or third day, the discolored areas being observed on the ventral surface, especially on the inner side of the thighs and are red or reddish purple in color. The ears may become tumefied, due to congestion and edema. The affected animals become weak as the disease progresses. They have uncertain

wabbling gait, are gaunt in appearance, refuse all food and usually die in from two to seven days. An occasional case recovers after being ill for several days. In such cases it is not uncommon for areas of skin or even the ears to slough, leaving ragged ugly wounds that heal very slowly. Such recovered hogs are permanently immune to hog cholera. In some instances the first manifestation of the disease is lameness, the disease sometimes being diagnosed as rheumatism.

In complicated cases the symptoms will vary according to the nature of the complication. When hog cholera is associated with necrotic enteritis the principal symptoms of uncomplicated cholera will be observed in addition to marked digestive derangements. There will be rise of temperature, impaired appetite, anorexia, vomition, diarrhea without the initial constipation, weakness, gauntness, and death. Cutaneous erythema may or may not occur; the ears usually become swollen and there may be sloughing of the ears, or portions of the skin; purulent conjunctivitis is usually present.

Hog cholera may be associated with pneumonia. These cases are manifested by the symptoms of hog cholera and disturbances of respiration, such as cough, nasal discharge and dyspnea, the intensity of the pneumonic symptoms depending upon the extent of the lung involved in the pneumonic process. The course of hog cholera complicated with pneumonia is relatively short and usually fatal.

Swine plague is frequently associated with hog cholera. The septicemic form of swine plague is manifested by symptoms very similar to those evidenced in cholera, and when this form of swine plague occurs as a complication of hog cholera it is not possible to recognize the existence of the two diseases. Swine affected with the combination of the septicemic form of swine plague and hog cholera evidence an extremely high temperature, anorexia and marked depression, and death occurs within a few hours after the onset. The pulmonary form of swine plague is the usual type of this disease that occurs as a complication of hog cholera and the symptoms manifested are practically the same as described in the pneumonic complication of hog cholera.

In some cases there is a combination of hog cholera, necrotic enteritis and the pulmonary form of swine plague or pneumonia. The symptoms manifested by such a combination of diseases will vary according to the intensity of each of the diseases. There will be high temperature, general lassitude, reluctance to move, arched back, depressed head, impaired appetite or inappetence, vomition, diarrhea,

cough, dyspnea, nasal and ocular discharge, cutaneous erythema, tumefactions and necrosis.

Diagnosis.—From the foregoing description of the lesions and symptoms of hog cholera it will be evident that the diagnosis is difficult. There are some laymen and an occasional veterinarian who diagnose all ailments of swine as hog cholera. Recent recognition of some other infections of swine have caused confusion to clinicians, and the identification of hog cholera has apparently become more difficult.

The symptoms evidenced may be suggestive of hog cholera, but a diagnosis should not be based upon symptoms alone. The lesions found in swine dead of cholera, excepting cloudy swelling, are not constant and uniform, but nevertheless are of value in arriving at a diagnosis. Hyperemia and hemorrhages in the submucosa, subserosa and lymph-glands, although they may be due to some associated condition are quite common and serve as a guide in diagnosis. The hemorrhages in the submucosa of the bladder and epiglottis, although not always present in cases of hog cholera, are considered when present as characteristic by many investigators. It is very probable that similar hemorrhages may be observed in cases of hemorrhagic septicemia. The so-called "turkey-egg kidney" is not characteristic of hog cholera, as this lesion occurs in hemorrhage septicemia and probably some other infections; however, this lesion may be observed in the carcasses of swine that have died of hog cholera.

Pneumonic lesions are relatively common in hog cholera. The lesion in the lung consists of croupous pneumonia and involves the cardiac or cephalic lobes. This lesion cannot be considered characteristic of hog cholera, as it is the typical lesion of croupous pneumonia.

Swine plague is distinguished from the pectoral form of cholera by the fact that the former is characterized by catarrhal pneumonia in the early stages of the disease, and by necrotic pneumonia in the later stages, and also by the presence of fibrinous pleurisy with or without adhesions.

Engorgement of the spleen is a common lesion in acute cholera, but this condition sometimes occurs as a result of disturbed digestion and as a result of leukemia, and is a common lesion of other septicemic diseases. Therefore enlarged spleen alone should not be considered a sufficient evidence upon which to base a diagnosis of cholera.

The congestion and hemorrhage of the lymph nodes is one of the most common lesions of cholera, but this lesion is not always present. Hemorrhages of the suberosa and submucosa are quite constant in

PLATE IV.

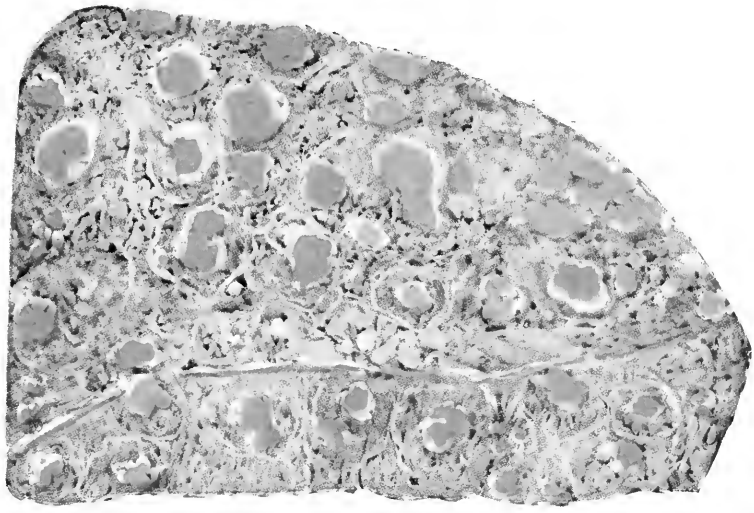

Fig. 1

Fig. 2

FIG. 1. Spleen showing calcified tubercles surrounded by hyperemic margins.

FIG. 2. Lung showing areas of normal tissue, areas of red hepatization and caseo-calcareous, tubercular areas.

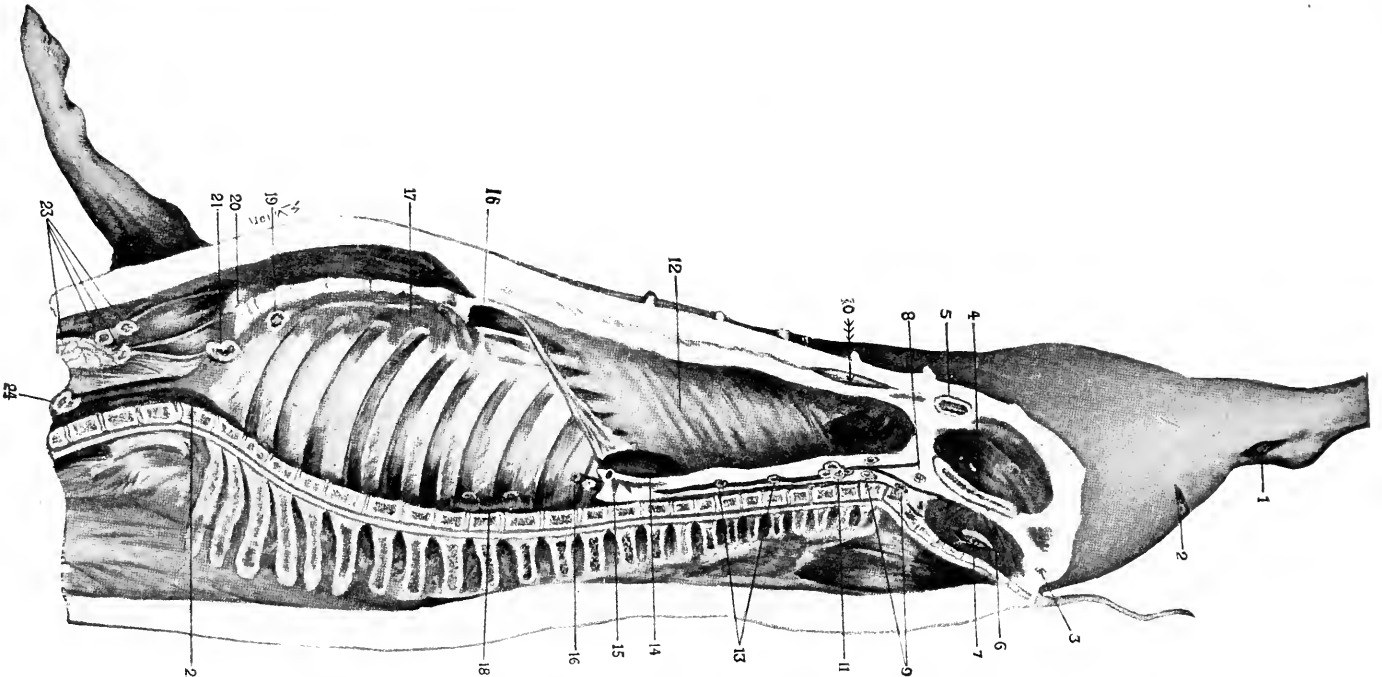

Fig. 77. 1, Incision to expose the gland of the hock; 2, popliteal lymph gland; 3, anal lymph gland; 5, superficial inguinal lymph gland; 6, internal obturator muscle; 7, ischial lymph gland; 8, posterior node of the internal iliac lymph glands; 9, subsacral lymph glands; 10, incision to expose the external inguinal lymph glands; 1, group of lymph glands in the sublumbar region, continuous with the internal iliacs; 13, sublumbar lymph nodes; 14, kidney; 16a, sterno-diaphragmatic lymph gland; 18, small lymph nodes along the aorta; 19, inferior thoracic or suprasternal lymph gland; 21, prepectoral lymph glands; 23, glands of the median cervical region, seen usually still attached in the dressed carcass; 24, post-pharyngeal or retropharyngeal lymph glands. (From Aureggio's "Album Guide.")

cholera; however, they may occur in any other septicemia. The changes of the bone marrow, although occurring to a less degree in other septic conditions, are among the most common lesions of cholera, but this lesion is absent in some of the peracute cases. Petechial hemorrhages are also of common occurrence in swine erysipelas, but this disease can be differentiated from cholera by the demonstration of the organism of swine erysipelas in the blood or splenic pulp.

The principal diagnostic lesions occurring in cases of cholera are

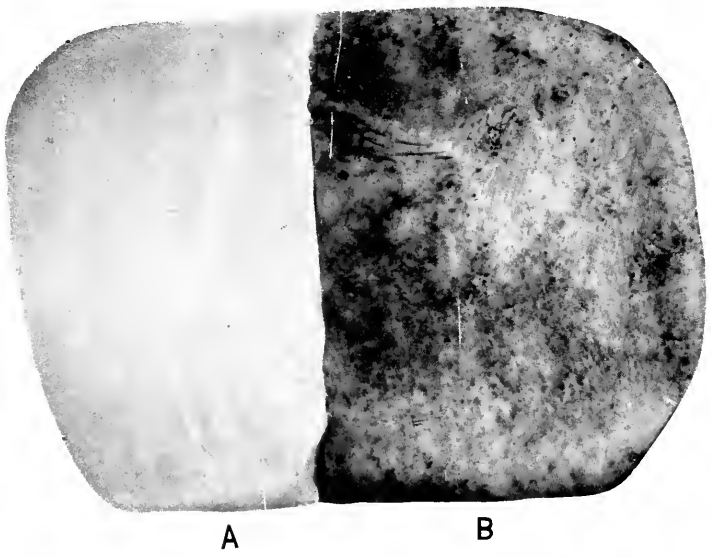

Fig. 78. Mucous membrane of the bladder. A, normal; B, showing inflammation due to hog cholera.

subserous and submucous hemorrhages, congestion and hemorrhages of the lymph nodes, and the discoloration of the bone marrow.

In the diagnosis, the history of the outbreak, and particularly the distance from known cases of cholera and whether or not any swine have recently been introduced, must always be taken into consideration. Finally, it must be understood that the only absolute method for the diagnosis of cholera at this time is the inoculation of a known, healthy, susceptible pig with from one to five cubic centimeters of filtered blood from the suspected animal.

Prognosis.—Cholera is a very fatal disease. The mortality varies from sixty to ninety-eight per cent.

Treatment.—It is probable that more proprietary remedies have been devised and advertised as hog cholera cures than for any other disease of domesticated animals. The application of therapeutic agents other than anti-hog cholera serum has not proved satisfactory in any proved outbreak of cholera. Hog cholera is a preventable disease, and prevention is far more satisfactory and economic than treatment of affected animals.

Hog houses and yards and hog pens should be located where they can be properly drained. It is not necessary for swine to have mud

Fig. 79. A wrong disposal of cholera hog carcasses. Chickens and dogs feeding on such carcasses may be prolific distributors of the infection.

and filth for their existence. They will thrive better when kept in sanitary quarters. The sheds and hog houses should be properly constructed in order that they can be kept in a sanitary condition. It has been the custom to consider that anything is good enough for swine. Thus many men having extensive financial interests in pork production are constantly seeking fermented grain and moldy and otherwise spoiled or damaged foods for their swine, because such foodstuff can usually be purchased for less money than a clean, wholesome food. But such foods interfere with the digestion, thus weakening the ani-

mals and rendering them more susceptible to disease. Swine that are given the proper diet are not necessarily immune to cholera, but they are much more resistant than swine affected with digestive derangements. Swine should also receive an abundance of clean, wholesome water, and not be permitted to drink water from polluted streams or stagnant pools. Many cases of what would probably have been fatal cases of cholera have been nursed back to health by providing good surroundings and a diet of clean, sweet milk.

Carcasses of swine, regardless of the cause of death, should be promptly disposed of, preferably by burning. To permit carcasses to putrefy in lots or other places, invites carrion birds and animals such as crows, buzzards, dogs, cats, wolves, foxes, rats, etc., and the dissemination by infection by such means may cause serious losses to neighbors or on remote farms. Barnyard fowls and pigeons are frequently the means of spreading infection from farm to farm.

Every well regulated farm has provision for isolation of new stock, such as boars, brood sows, or stocker hogs. It is also advisable to quarantine all swine that have been used for exhibition purposes at state fairs or stock shows. The period of quarantine should never be less than three weeks. By this measure many general outbreaks of hog cholera and other infective diseases of swine can be prevented. Whenever disease appears on a farm it should be rigidly quarantined to prevent the spread of infection to adjacent farms. Police regulations and general sanitary measures should be instituted or more rigidly enforced if they have been provided for by the various live stock sanitary boards. The following rules and regulations have been recommended and if enforced will be an important factor in diminishing the losses incidental to hog cholera.

1. The shipment or movement, interstate, of swine affected with cholera to be prohibited.
2. Exposed swine to be shipped under permit and placard.
3. The movement of cholera-infected swine over the public highways to be prohibited.
4. Provision for moving exposed swine under permit in approved manner.
5. Carcasses of animals, and particularly of swine that have died of cholera, to be burned within twenty-four hours after death, or under special permit to be disposed of otherwise.
6. The shipment by rail of swine for purposes other than immediate slaughter to be permitted only through special pens and unload-

ing chutes, or through portable chutes directly into wagons. If unloaded in regular loading pens, to be moved under permit in approved manner.

7. Public stockyards to be under close supervision and cleaned and disinfected at intervals determined by the proper state authorities.

8. Railway cars for the transportation of swine other than such as are intended for immediate slaughter, to be cleaned, washed and disinfected before swine are loaded.

9. All cars in which diseased swine are found, or in which exposed swine are shipped for immediate slaughter, to be cleaned, washed, and disinfected within twenty-four hours after unloading, or cars to be held until the presence or absence of disease has been determined.

10. All cars or vehicles of transportation carrying cholera-exposed swine to be placarded in a conspicuous manner, "Cholera Exposed Swine for Immediate Slaughter."

11. Owners of swine and persons in charge, including attending veterinarians, to report without delay to state authorities all outbreaks of cholera among swine.

12. Live stock sanitary authorities to quarantine all infected herds and premises, but may permit shipment of exposed swine for immediate slaughter as above provided.

13. Infected premises to be quarantined not less than sixty days after last traces of disease have disappeared and premises have been cleaned and disinfected.

14. Infected premises to be cleaned and disinfected under supervision prescribed by live stock sanitary authorities.

15. Live stock sanitary authorities to be given power to provide in a practicable manner against the dangerous pollution of streams with hog-cholera virus and provide for the safe disposal of garbage liable to be infected with hog-cholera virus.

16. To prevent the spread of hog cholera by swine shown for exhibition purposes, such swine to be treated with serum and virus not less than forty days prior to the opening date of the exhibit, or with serum alone not more than fifteen days before such time.

17. Provision for controlling for thirty days, by quarantine or otherwise when deemed advisable by the proper authority, of all swine treated with serum-virus, or premises on which such swine are kept, to prevent danger of possible spread of infection from inoculated animals.

If the above or similar regulations could be instituted and enforced

cholera in swine would be materially diminished. Since the advent of anti-hog cholera serum the enforcement of sanitary regulations has been neglected. In order to obtain and enforce efficient sanitary measures the pork producers must first be educated to the necessity of such measures.

The application of some of the simple sanitary rules have proved of great monetary value to swine raisers. As an illustration, the separation of the infected from the healthy swine following the use of a clinical thermometer, and the proper after-care, have been the means of saving over fifty per cent of many infected herds. If as much consideration were given to proper hygienic care and sanitary control, as is given to the production, distribution and application of serum, hog cholera would soon become a much less serious disease.

Preventive treatment.—The first use of serum for the prevention of hog cholera was made in 1897 by Preisz, who obtained it from a swine that had recovered from cholera. In 1904 De Schweinitz and Dorset demonstrated that hog cholera was caused by a filtrable virus, and soon after, Dorset, McBryde, and Niles devised a plan of hyperimmunizing swine for the purpose of producing anti-hog cholera serum. This serum came into general use about 1908, and is now being used extensively in the United States.

It is prepared on the following general plan, different manufacturers having slightly different methods.

The production of serum is of considerable importance, and a brief description of the general process follows:

Swine having a large carcass and weighing 225 to 275 pounds are selected, and if they are not known to be immune they are simultaneously immunized. Swine must have been immune for not less than 60 days prior to hyperimmunization. The swine used for hyperimmunes may be tuberculin tested and the reactors discarded. A prerequisite of the hyperimmunizing process consists in having all instruments and equipment sterile and environments that are conducive to asepsis. The immune swine that are to be hyperimmunized should be kept in a pasture or yards that are concreted to prevent undue filthiness. The virus used is obtained by injecting healthy, susceptible pigs with one or two cubic centimeters of virus. A pig weighing from sixty to ninety pounds is usually used. The virus pigs should be carefully observed, and temperature records maintained. If susceptible pigs have been injected with a virulent virus there will be evidence of the disease in four to seven days, and from

the seventh to the ninth day the temperature of the pig will probably range from 105 to 108 degrees Fahrenheit, and is then prepared for slaughter by thoroughly washing and applying some disinfectant to the skin of the ventral surface of the body. In addition to these precautions the inferior cervical region is shaved. The entire pig is shrouded with moist, antiseptic gauze to prevent any particles of dust from dropping into the vessels used in collecting the virus. The blood-vessels are severed, and the blood is collected in a sterile vessel and the fibrin whipped and removed. The remainder of the blood is filtered through gauze, and constitutes the virus blood. The virus pig is then autopsied, and if lesions of cholera are not found, or if lesions of other diseases are found, the collected virus blood is discarded.

Hyperimmunizing is accomplished by the intravenous injections of virus. For the hyperimmunization at least five cubic centimeters of virus are used to the pound weight of the hog that is being hyperimmunized. This quantity is given as a single injection. In the intravenous method the injection is made in an ear vein after properly cleansing and securing the animal. Various devices are used in making the injection. The principle involved is to force the virus into the vein slowly. The virus should be near the body temperature when injected. In the intra-muscular method the virus is injected in the interstices between the muscle bundles, selecting two, three, or four locations, as the inner thigh muscles and the subscapular region. The intraperitoneal injection is made by passing a long needle through the abdominal parietes into the peritoneal cavity.

The hyperimmunes are kept in clean, sanitary pens and a temperature record maintained in order that the producer may know when the reaction is over. When the temperature assumes the normal the blood contains the antibodies. Two methods of bleeding hyperimmunes are in use—the slaughter method and tail bleeding. By the slaughter method practically all of the blood is obtained. By the tail-bleeding process from two to three bleedings are made, and the swine are re-hyperimmunized, and after the reaction they are used for bleeding. Sometimes the hyperimmune is tail bled for one, two, or three times and then slaughtered. Each method has some advantages and some disadvantages. The slaughter method is the most rapid—in other words, more serum can be produced in a given length of time than by tail-bleeding. Tail-bleeding is the most economical method of producing serum, and antiseptic precautions can be carried out more effectually.

Proper equipment is required for either process, and the instruments, bottles, and other utensils used must be sterile and the environment must be conducive to asepsis.

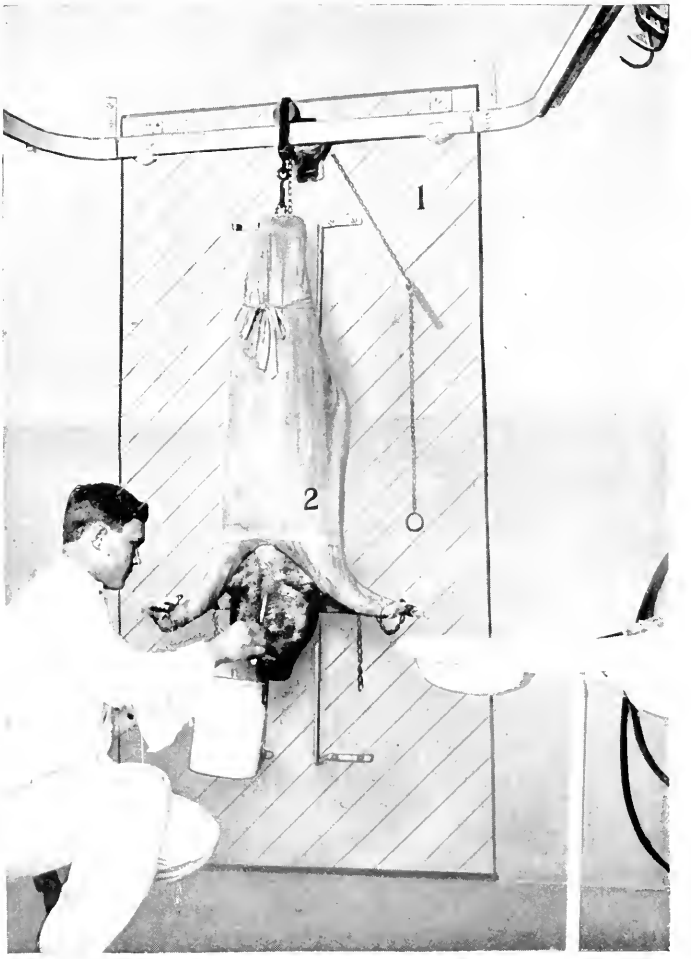

Fig. 80. VIRUS BLEEDING ROOM. 1, Revolving door upon which the pig is secured and cleaned. The door is then turned, bringing the pig into the bleeding room; 2, shrouded pig.

The blood obtained from hyperimmune swine is whipped, the fibrin being removed and the remaining portion of the blood filtered through gauze. The blood from each hog is kept separate until the

carcass is autopsied and the absence of cholera and other diseases is demonstrated. Centrifugation of the blood is being practiced by some producers, and this should be encouraged, as a cleaner product and one that is more easily injected is produced.

Clarified anti-hog cholera serum is the name applied to a specially prepared serum from hyperimmune swine. This serum is free from blood cells and fibrin and practically free from hemoglobin. A relatively smaller dose is required of clarified than of ordinary serum, and abscess formation is less likely to occur by use than with the usual anti-hog cholera serum.

The blood obtained from hyperimmune swine by either process is preserved by adding a small percentage of phenol or trikresol and properly sealed and placed in storage at a temperature of about 50 degrees Fahrenheit. Before the serum is used it is tested. First, second, and third bleedings from different hyperimmunes, or the blood from different hyperimmunes obtained by slaughtering, are mixed up to quantities of 80,000 cubic centimeters. This amount constitutes a series, and therefore each series is a composite serum. For a test sample a proportionate quantity is taken from each separate quantity that makes up a series. The sample should be obtained immediately after bleeding, thus obviating reopening of the bottles.

For the test seven healthy, susceptible pigs, weighing from forty-five to ninety pounds each, are selected. These pigs are maintained in special pens. The test is made as follows: Each of the seven pigs is injected with two cubic centimeters of virus and five of them receive twenty cubic centimeters of serum. The two pigs are designated check pigs, and they should show visible symptoms and die of typical cholera within twelve to eighteen days. A temperature record is maintained for twenty days, and from observing this record the virulence of the virus and the potency of the serum can in a measure be determined.

This test is not absolute, but it is of value as an indicator. The test should be repeated if the following conditions arise. First, if the check pigs should not show any evidence of cholera within ten to fifteen days; second, if the check pigs or any of the other five should show a constant high temperature beginning on the second, third or fourth day after the test begins; third, if either of the five pigs should die of cholera during the time of the test.

The serum that has been tested and in which the two check pigs have died of cholera and the five pigs have shown no visible illness nor any constant rise of temperature is ready for mixing and bottling,

after which it is ready for use. The laboratory for mixing and bottling must be properly constructed in order that contamination of the serum may be reduced to a minimum and the necessary equipment, such as sterilizers, must be provided.

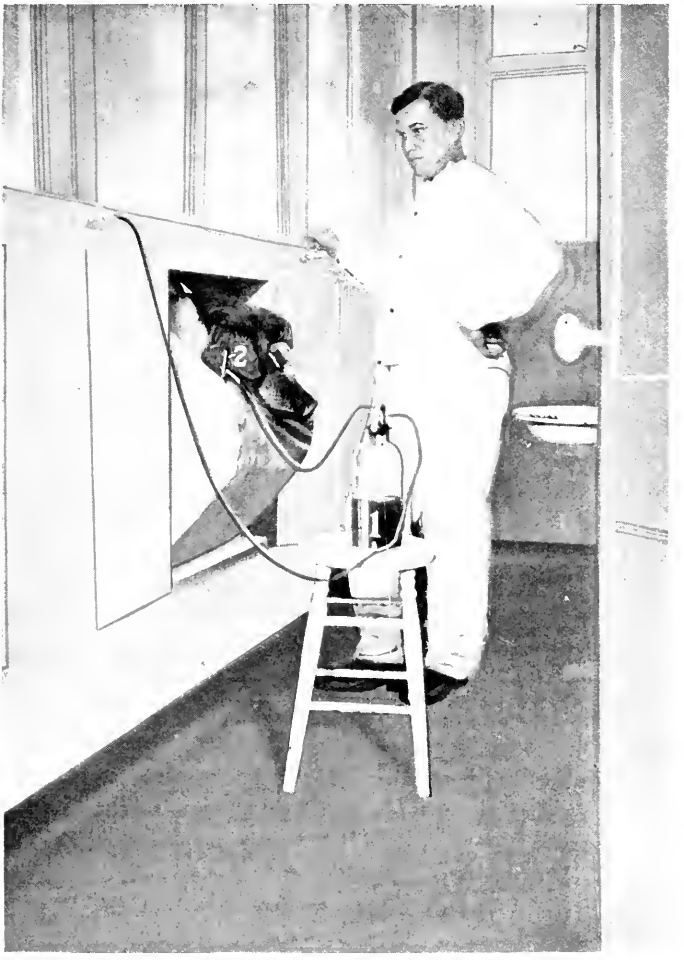

Fig. 81. HYPERIMMUNIZING ROOM. 1, virus-container showing attachment to pressure tank; 2, needle inserted into the ear vein.

For mixing the serum a container must be selected that can be sterilized and from which the serum can be bottled.

After thoroughly mixing the serum constituting a series it is with-

drawn into sterile bottles, the size of which will be determined by the demand. The bottles are properly sealed, labeled, and wrapped, and until needed put back in storage at a temperature not to exceed 50 degrees Fahrenheit.

The foregoing description is the general method of production of anti-hog-cholera serum. Many little factors that are of considerable importance have not been enumerated. The accompanying illustrations may convey some idea of the problems of the production of this product. The production of anti-hog-cholera serum has become of such vast importance to the swine industry of the country that Congress has provided means for its regulation in order that a potent serum may be obtained.

SERUM PRODUCTION

The following is a general description of requirements for serum production.

LOCATION OF BUILDINGS

Location to be such that surroundings will not interfere with sanitary production and that their operation will not contaminate surrounding areas.

CONSTRUCTION OF BUILDINGS

The construction of buildings to be of material that will permit of daily cleaning and disinfection, stone, brick, tile, and concrete being especially recommended.

ARRANGEMENT OF PLANT

1. The arrangement and equipment of buildings to be such as to insure the production of a pure and uncontaminated product.

2. Swine to be kept in separate buildings located a sufficient distance from the building containing the bleeding (either virus or serum) and hyperimmunizing rooms in which swine are to be placed for the latter purpose only.

3. The serum bleeding room, the virus bleeding room, and the hyperimmunizing room to be separate and distinct rooms.

4. The preparation of serum, and the preparation of virus from the whole blood, to be operations conducted in separate and distinct rooms without direct communication with each other or with the foregoing not larger than an opening which will permit the transfer of receptacles containing the freshly drawn blood, and to be used for no other purpose.

5. Separate washing and sterilizing rooms to be provided.

6. The prepared serum and virus to be stored in properly cooled rooms.

7. Swine kept for virus production and the testing of serum to be properly isolated so as to reduce to a minimum the danger of spreading infection. Separate and distinct feed rooms to be provided for such animals.

8. Mortuary, crematory, abattoir, and desiccating or rendering plant

operated for utilizing the waste products of the establishment to be located so as to prevent contamination from this source.

9. Necessary dressing and toilet rooms, properly equipped and located, to be provided. Also bottling and packing rooms.

10. Provision for the sanitary disposal of all manure, offal and debris.

OPERATION

1. The operation of serum plants to be under the direct supervision of a competent veterinarian or other professional man whose training and experience have fitted him for this work.

2. Prohibition of the sale of serum and virus produced from animals affected with any contagious disease other than hog cholera and of any contaminated serum or virus.

Fig. 82. SERUM CENTRIFUGING ROOM. 1, a ten-quart centrifuge; 2, a four-quart centrifuge.

1. Electric sterilizer. 2. Autoclave. 3. Type of utensil used for collecting blood

3. Provision requiring full and complete records of all steps in the manufacture and test of serum or virus.

4. The label on the container of serum or virus to show the true name of the product, the name or number of the manufacturer, the date of preparation, or the date after which the manufacturer no longer guarantees the product, and a serial number to identify the product with the records of the establishment.

Two general methods are utilized in the immunization of swine with anti-hog-cholera serum—the serum alone method and the simultaneous method.

The exact method of administering serum has been freely discussed at various associations, and numerous articles have appeared in various publications. The operator must always provide clean and sterile instruments. It is true that the instruments become contaminated as soon as used, but at least two needles should be provided in order that one may be placed in a disinfecting solution while the other is in use. The syringe should be sterilized by boiling after being used for a few hours or after a herd has been immunized, before using it on another herd. The serum and virus should be injected deeply into the muscle or preferably into the axillary space, in order to insure

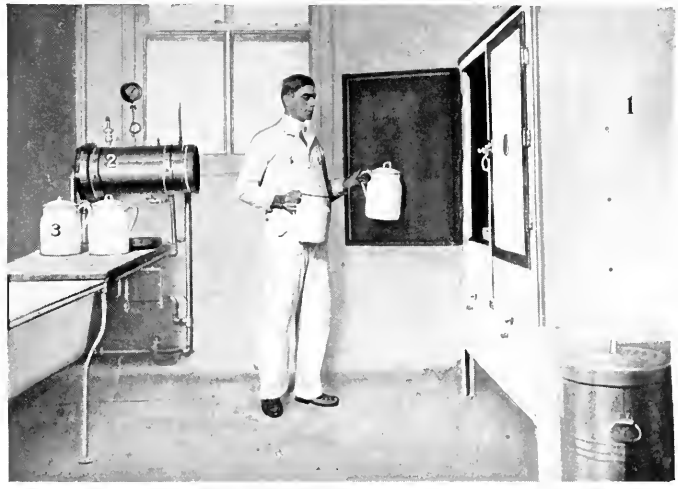

Fig. 83. STERILIZING ROOM. 1, electric sterilizer; 2, autoclave; 3, type of utensil used for collecting blood.

rapid absorption. Bad results are frequently due to failure of absorption of the serum or virus that has been injected just beneath the skin in the subcutaneous fat. Swine that are in filthy, muddy pens should not be injected, because of the probability of infection in the needle wounds, and swine that have quantities of mud or filth upon their bodies should not be injected. All swine that are injected should be reasonably clean, the point of injection should be painted with tincture of iodin, and the skin should be pinched after withdrawing the needle to prevent leakage.

The serum-alone method produces an immunity for a period of from one week to three months, but it does not entail any danger of

infecting and producing cholera in a cholera-free herd and establishing new centers of cholera in a community free from the disease. By the proper use of serum alone in communities where there are only a few centers, cholera could be efficiently controlled. In such cases the infected herd and all surrounding herds should be immunized and if necessary the process could be repeated six weeks later. This method of control is not as applicable when several counties of a state, or the entire state, is infected. Serum alone, when given in large doses, is of considerable value in the incubation period of the disease before the animals show visible symptoms but after the temperature has risen. The judicious use of serum in such cases has saved as high as eighty or ninety per cent of the exposed herd. The dose of serum in the serum-alone treatment depends upon the susceptibility of the pigs and the potency of the serum. The following schedule of serum dosage for serum-alone treatment in non-infected swine has been suggested:

Weight of Hog	Dose of Serum
Below 10 pounds	10 cubic centimeters
10 to 15 pounds	15 cubic centimeters
20 to 30 pounds	20 to 25 cubic centimeters
40 to 75 pounds	30 cubic centimeters
100 to 150 pounds	40 to 60 cubic centimeters
175 pounds and over	80 cubic centimeters

The above dosage should be increased about 50 per cent.

Serum-alone treatment is indicated in infected swine and in exposed swine that are to be marketed within three or four weeks.

The simultaneous method is used more extensively than the serum alone, because it produces a longer immunity. The dose of serum used in the simultaneous method should be fifty per cent more than the dose in the serum-alone method. Not less than one mil of virus should be used, and for swine weighing over 60 pounds better results have been reported when 2 mils of virus were used.

The serum and virus must be introduced separately into different parts of the body. This method may be used successfully in exposed herds, especially in swine that do not show a high temperature. But the virus should not be given to hogs that are showing visible signs of cholera. The one serious disadvantage of the simultaneous method is the fact that infection is introduced. Good authorities claim that a hog immunized by the simultaneous method does not eliminate the virus unless he dies of the disease.

The principal advantage of the simultaneous method of immuni-

zation is that a more lasting and permanent immunity is produced. The general opinion has prevailed that young pigs could not be permanently immunized even by the simultaneous method, but according to a recent report of a series of experiments conducted by or under the supervision of the Bureau of Animal Industry, pigs from one to three weeks of age were permanently immunized against cholera by the simultaneous method. This experiment simplifies the immunization of swine against cholera and should be practiced in swine-raising districts as the dosage required for pigs is relatively small and the expense to the owner would be materially less than for the immunization of larger swine.

A so-called double method has been advocated by some for the prevention of cholera. It consists of the serum-alone immunization,

Fig. 84. CHOLERA IMMUNE HOGS. These hogs were used at the Chicago stockyards, and were driven from pen to pen to clean up the food left by cattle and other hogs. They were, of course, constantly exposed to virulent infection.

followed ten days later by the simultaneous method. This so-called double method should not be used because the virus used in the simultaneous method is apparently rendered inactive or at least a permanent immunity is not produced.

Hog cholera can be controlled by the rational application of anti-hog cholera serum combined with the proper enforcement of sanitary regulations.

Swine Plague (Hemorrhagic Septicemia)

Swine plague, also designated hemorrhagic septicemia, is a specific infectious disease of swine caused by the Bacillus suisepticus.

The presence of this disease in the United States is now apparently accepted by practically all investigators and state sanitary officials. This disease is not so fatal, neither is it so widespread, as cholera. It may occur sporadically or enzootically, but it rarely assumes an epizootic form. The percentage of losses in affected herds varies markedly, reaching as high as 75 in some instances. The greatest losses occur when animals are not kept in proper sanitary quarters, such as dusty or muddy pens, or in animals sleeping in wet, or damp quarters.

Etiology.—The cause of swine plague is the B. suisepticus. This micro-organism is representative of the hemorrhagic septicemia group. The B. suisepticus is a short, bipolar-staining, polymorphic non-motile organism, and does not form spores. The organism grows readily on practically all culture media, aerobically or anaerobically. It does not liquefy gelatine or coagulate milk, and is not stained by Gram's method.

Its vitality is prolonged for from five to fifteen days in soil, feces and water when not exposed to sunlight, but is destroyed in two or or three days by desiccation, and is easily destroyed by weak antiseptics. The organism is killed in twenty minutes by a temperature of fifty-eight degrees Centigrade.

Fowls, rabbits and guinea pigs are susceptible to the pathogenic action of these organisms. The virulence of the B. suisepticus is quite variable and is likely to vary quite suddenly. Intrapulmonary injections into swine usually produce multiple catarrhal pneumonia succeeded by necrotic pneumonia.

Cahill has produced hemorrhagic septicemia in swine immune to hog cholera by the injection of blood from a pig dead of hemorrhagic septicemia; also by the injection of pure cultures of B. suisepticus.

There is some doubt as to just what factors are necessary to bring about an outbreak of swine plague. Certain it is that the infection is more widespread than the disease. It appears that something to lower the normal resistance of the animal is necessary in addition to the B. suisepticus to bring about the disease. Swine plague is prone to appear in animals suffering from cholera; in animals subject to the hardships of shipping; in pigs at weaning time; in herds suddenly placed on green corn for feed; in young animals subjected to unusual exposure, as to a cold rain in early spring or late fall, and, as is well recognized, in animals kept in dusty quarters.

Further, swine plague is quite apt to occur in swine recently

vaccinated against hog cholera, particularly if good sanitation is not observed. It has been noted many times as being concomitant with necrobacillosis; in short, the infection being almost universally distributed, may be expected to set up a disturbance in a great variety of conditions where the vitality of the exposed animal is lowered.

The amount of infection present also has its bearing on the extension of the disease, since once it has become active in any of the indi-

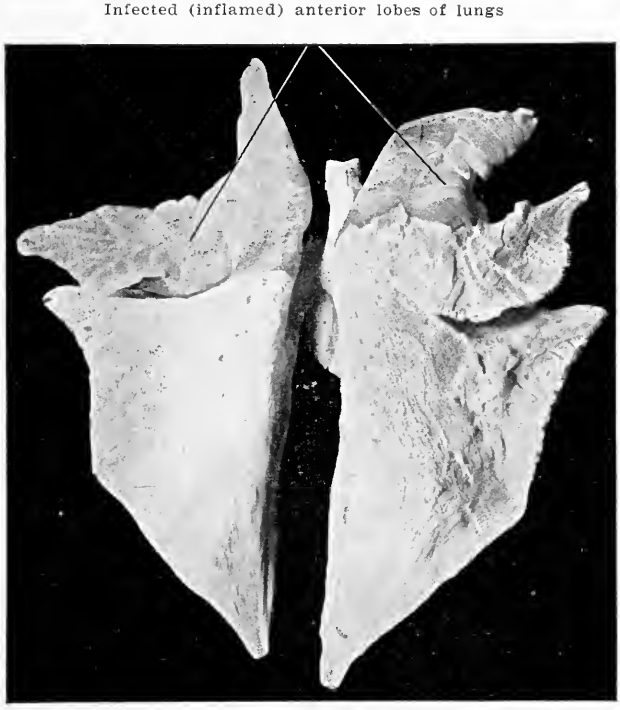

Fig. 85. Hog lungs with chronic swine plague, anterior lobes affected. (Ostertag.)

viduals of a given herd, swine plague is quite apt to extend to all swine associated with the affected animals, even though they may seem healthy and apparently possess a normal resistance to the infection.

Source of infection.—Bacilli suisepticus, like the other representatives of this group, are widely distributed. They are frequently found in the respiratory passages of normal swine. Their virulence

is variable, and it seems plausible that some predisposing condition must exist in the swine that become affected, or the organism suddenly, for some reason unexplained, becomes sufficiently virulent to produce the disease. In most severe outbreaks it appears that the virulent organisms are transmitted from the diseased to the susceptible swine, or at least the disease may become enzootic in a very short time.

Channel of entrance.—The channel of entrance may be by way of the respiratory organs, although the microorganism may be successfully introduced through the digestive tract or skin.

Lesions.—This disease assumes different types or forms. The following types have been recognized: the septicemic, the pulmonary, and the intestinal. It is not uncommon to find the pulmonary and intestinal types existing at the same time. In other instances either the pulmonary or intestinal type may represent the primary condition, and the septicemic type develop in the same animal, and usually result fatally.

The septicemic form is characterized by petechial hemorrhages in the skin and in the serous and mucous membranes. There may also be some enlargement of the lymph-nodes and of the spleen. The pulmonary form of the disease is characterized by an atypical catarrhal pneumonia, different areas of the lung showing different stages of progress of the disease, such as congestion, red hepatization, gray hepatization, and later necrosis, in which the necrotic material may be liquid or caseous. As a result of the variation of the progress of the disease in different areas, the affected lung has a marbled or mottled appearance. There are some interlobular infiltrations; the bronchial and mediastinal glands may contain hemorrhages or necrotic centers; the pleura is usually affected with a fibrinous pleurisy with or without adhesions. In the more chronic cases the necrotic foci in the lung become more numerous and there may be a purulent or septic pleurisy, the discharge into the pleural cavity of the contents of necrotic pulmonary centers. There will be a diffuse redness of the skin.

The intestinal form of the disease is usually manifested by hemorrhages and inflammation, the inflammatory process resulting in the deposit of a sticky tenacious exudate, which may be uniformly distributed upon the mucosa of the large or small intestine, or it may appear as scattered areas. The exudate adheres tenaciously to the mucous membrane. The related lymph-glands are usually tumefied

and may be hemorrhagic but there is no peripheral hemorrhage. The spleen may or may not be enlarged. This form of the disease is frequently associated with disturbances caused by the B. suipestifer, colon bacillus, Bacillus typhosus and Bacillus enteritidis, but it is probable that the B. suisepticus is the primary disturbing factor.

It is possible that a cerebral form of this disease may exist.

Swine plague is frequently associated with hog cholera, and the various lesions characterizing that disease will then be present also, all of the lesions being variously modified.

Symptoms.—The period of incubation, at least in artifically infected cases, is of short duration, rarely exceeding two days. The septicemic type is ushered in suddenly with a high temperature,

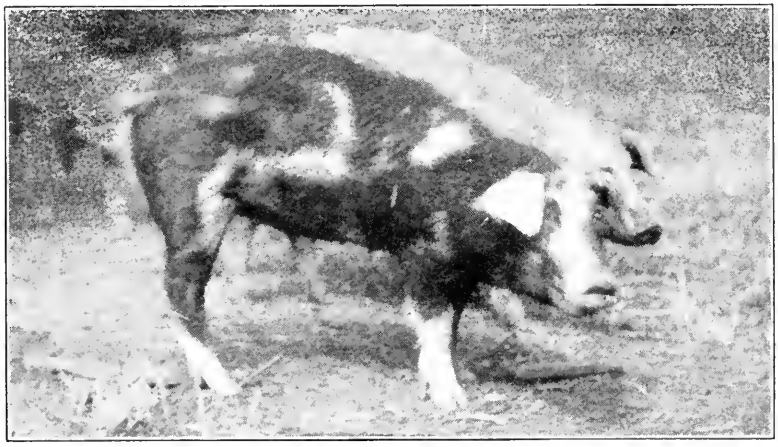

Fig. 86. Pulmonary mixed infection, catarrhal pneumonia.

though it rarely exceeds 105 degrees Fahrenheit, accompanied by inappetence, weakness, and little tendency to move. The blush of the skin due to hyperemia may be observed. This form is rapidly fatal, the course rarely exceeding twelve hours.

The pulmonary form of swine plague is evidenced by the usual symptoms of pneumonia, such as short, dry, spasmodic cough, dyspnea, temperature up to 105 degrees Fahrenheit, a disposition on the part of the affected animals frequently to sit on their haunches like a dog, mucous or mucopurulent nasal discharge, diminished appetite and finally cessation of appetite, and usually constipation. As the disease progresses, breathing becomes more difficult and there is ex-

treme weakness and emaciation if the affected animals live long enough. The blush of the skin is usually present and there may be conjunctivitis. The acute form usually terminates fatally in about one week, but more rarely the disease becomes chronic.

The subacute or chronic pulmonary form is evidenced by spasmodic cough, temperature of about 104 degrees Fahrenheit, poor appetite, emaciation, and weakness, the animals usually dying of exhaustion in from four to eight weeks.

The intestinal form of this disease is evidenced by digestive derangement. There is usually diarrhea which persists and the animal emaciates rapidly and becomes weakened and dies in from a few days to perhaps two weeks after the onset. During practically the entire course of the disease the appetite remains good. This par-

Fig. 87. A group of pigs taken from a herd in which could be found symptoms of various diseases. The two pigs at the left (X) show symptoms of cholera. Autopsy showed lesions of cholera predominating, while autopsy of the pig in the center (O) showed well marked lesions of necrotic enteritis.

ticular type of the disease in some localities is designated as the drying-up disease.

Diagnosis.—The diagnosis of swine plague is attended with considerable difficulty. The septicemic form can be distinguished from the uncomplicated septicemic form of hog cholera only by the demonstration in the blood of the Bacillus suisepticus and the presence of hog cholera virus by the production of hog cholera by inoculation with the filtered blood.

From the pneumonia of hog cholera the pulmonary form of swine plague is differentiated only by autopsy. The lung lesions in hog

cholera consist of a typical croupous pneumonia and in the later stages of necrosis.

Verminous pneumonia.—May be differentiated from swine plague by the chronicity of the attack, the wheezing respiration, and the demonstration on autopsy of the Strongylus paradoxus. The ver-

Fig. 88. A group of pigs showing various symptoms. Note the spotted pig at the left holding its right front foot up. Rheumatic arthritis is present, due to circulation of toxins in the system.

minous pneumonia caused by the development of the larval form of the Ascaris suum is embolic in character and may be identified by demonstration of the larvae microscopically.

Catarrhal pneumonia.—Is differentiated from swine plague pneu-

Fig. 89. A bad bunch of sick hogs. Some went down, others had paroxysms of coughing; many went down in the back.

monia by the fact that the former disease occurs only in young pigs and is sporadic, and rarely are the necrotic centers typical of swine

plague found in the lung. Pleuritic complications are also the exception in catarrhal pneumonia.

Treatment.—Prevention by the enforcement of sanitary regulations is important. The spread of this disease seems to be favored by dry weather; consequently, sprinkling pens and houses with disinfectant solutions is helpful.

Good results have been obtained by the use of bacterin prepared from the B. suisepticus. The good results that may be obtained from the use of bacterin depend primarily upon an accurate diagnosis. In other words, it is futile to hope for good results following the administration of bacterin in cases of cholera, verminous bronchitis or sporadic cases of bronchial pneumonia.

The bacterin may be injected at the base of the ear. Single doses are ordinarily sufficient to produce immunity, but where one is desirous of a more positive immunity, it is best to give a second injection three or four days after the first.

The method of administering the bacterin depends upon the size of the hogs and the number in question. Pigs are conveniently injected with the swine plague bacterin by having them caught by an attendant and injecting the bacterin either in the thigh or in the axillary space. The site of injection should not be covered with mud or dirt, but if the skin is dry, the injection may be made after the application of a disinfectant. Larger hogs may be driven into a chute and the injection made by introducing the needle deeply at the base of the ear. The syringe and needles should be cleansed and sterilized prior to use.

Infectious Necrotic Enteritis

Infectious necrotic enteritis is a name applied to a disease or condition that is relatively common in swine and was formerly described as chronic hog cholera or an intestinal form of cholera. This condition is frequently designated as "mixed infection" or intestinal necrobacillosis.

This disease has probably been more prevalent than any other infectious disease of hogs in the corn belt of the United States during the last two or three years. It is the most common condition found in immunized swine in which the so-called "hog cholera breaks" occur. In fact, many veterinarians make no distinction between infectious necrotic enteritis and hog cholera. It has been experimentally demonstrated that infectious necrotic enteritis occurs independ-

ently of hog cholera, although it is a frequent complication of that disease. Swine plague and infectious necrotic enteritis are distinct disease conditions, although they frequently occur as associated conditions.

Pigs weighing 30 to 50 pounds are probably most frequently affected with infectious necrotic enteritis, although it may occur in recently farrowed pigs and aged hogs. (The consideration of this condition in recently farrowed pigs will be discussed under the head of "Scour in Pigs".)

Fig. 90. Insanitary conditions that predispose to a variety of infections. The conditions shown above are clearly conducive to all kinds of infection. Note the pool of stagnant water surrounded by mud wallows, manure and decaying vegetable matter.

Breed appears to play no part as regards susceptibility to this disease. Condition of the swine undoubtedly is a factor in susceptibility; however, shotes in the best of condition become affected. Climatic conditions have little or no influence in the prevalence of infectious necrotic enteritis, although the disease appears to be more common in late spring and early autumn, probably because that is the season when the majority of the pig crop is of the most susceptible age. Sanitary conditions in which the swine are maintained have an influence upon the susceptibility of swine to the infection; however, the

disease may prevail in swine that are kept in clean sanitary quarters. Food seems to have little, if any, influence upon the prevalence of the disease, although insufficient or poor quality of feed would no doubt predispose to this disease, the same as to any other diseased condition.

Etiology.—The specific cause of infectious necrotic enteritis has not been identified. This condition is not the result of the filtrable virus that produces hog cholera, for it has been demonstrated by the injection of filtered blood from uncomplicated cases of infectious necrotic enteritis into swine that were susceptible to hog cholera that the filtrable virus does not exist, at least in sufficient quantities or of sufficient virulence to produce disease. By experiment it has been demonstrated, although the findings are not positively conclusive, that the B. necrophorus is not the primary cause of this condition. Likewise, it has been rather conclusively demonstrated that the B. bi-

Fig. 91. Group of pigs affected with necrotic enteritis. These animals were maintained in pens that were as insanitary as could possibly be imagined. Note the general unthrifty appearance.

polaris suis is only a secondary invader in infectious necrotic enteritis. By a microscopic examination of the lesions in the intestine it is possible to demonstrate the B. necrophorus in an occasional case of this disease, the B. bipolaris suis in over 50 per cent of the cases, the B. coli communis in practically all cases, the B. paratyphoid A & B in a few cases, and perhaps a variety of other microbian agents in various cases, but the principal incriminating evidence at this time is in support of the B. suipestifer as the principal or causative factor of infectious necrotic enteritis in swine. The B. suipestifer has been described as occurring normally in the intestine of healthy swine, but recent investigations by Jordan and Ten Broeck indicate that this organism does not normally inhabit the intestine of swine and when found in normal animals its occurrence is looked upon as an indication of a carrier. The B. suipestifer occurs regularly in the intestinal lesion and in other tissue of affected animals, and it is possible that the final proof of its causal relation to infec-

tious necrotic enteritis will be established in the not far distant future. It seems probable that intestinal parasites are important predisposing factors, probably because of injury to the intestinal mucosa which provides a favorable field for action. The probable usual method of entrance of the infection is in the feed or water, by way of the digestive tract.

Lesions.—The principal lesions of infectious necrotic enteritis occur in the mucous membrane of the intestine. In some cases the lesions indicate that the infection begins in the lymphoid tissue (Peyer's patches and solitary follicles) of the intestinal mucosa near the ileocecal valve. The lesions may be found in any portion of the di-

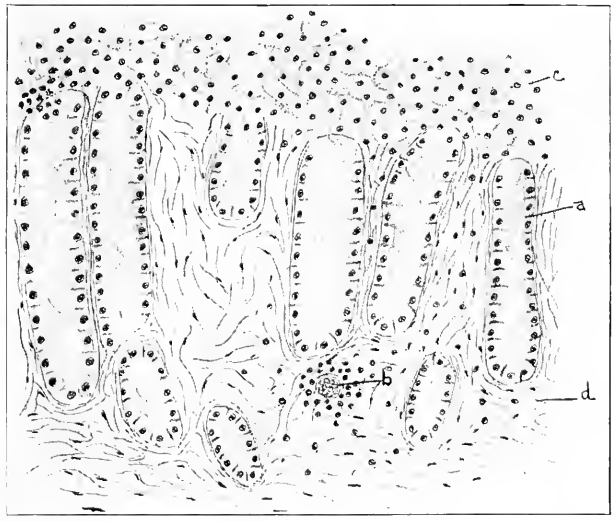

Fig. 92. DIPHTHERITIC ENTERITIS. A, gland; B, congested stroma vessel; C, fibrinous exudate; D, organized fibrin in stroma.

gestive tube including the stomach, but are usually more extensive in the intestine. In the beginning the lymphoid areas become congested and tumefied and later undergo necrosis. In other cases the lesions are apparently not confined to the lymphoid tissue, but invade the mucosa which becomes congested, tumefied and necrotic. When large areas of the mucous membrane become involved the lesion appears as a diphtheritic inflammation because of the adherent necrotic tissue. In some cases the entire intestinal wall appears thickened and friable, due to the accumulated necrotic tissue. Some cases are observed in

which the necrotic tissue has sloughed, leaving the intestinal wall relatively thin and inelastic.

In prolonged cases or the chronic form of this disease the so-called "button ulcer" is of common occurrence. This lesion occurs when the infection is apparently localized in solitary follicles or Peyer's patches and the inflammatory and necrotic processes extend by continuity, the necrotic tissue remaining intact or accumulating as dirty brown masses with raised margins. Microscopically the surface epithelium in the affected areas and the lymphoid tissue are found to be in various stages of degeneration and disintegration. The degenerated and dead cells commingle with the coagulated inflammatory exudate and appear upon the surface as an adherent mass.

The mesenteric lymph-glands through which the lymph passes from the infected mucosa are tumefied and may be congested and hemorrhagic. In the subacute or chronic cases the central portion of the lymph-glands may be necrotic. The peritoneum adjacent to the involved intestine is invariably affected with a subacute or chronic inflammation. The peritoneal inflammation is manifested in the early stages by an excessive outpouring of serous fluids, but as the process continues there is a tendency to organization and limited fibrous proliferation which is prone to produce adhesions.

When complicated with the filtrable virus disease, the lesions of infectious necrotic enteritis and those that are attributed to hog cholera prevail. In the combination of the two diseases the lymph-gland lesions are more prominent than in infectious necrotic enteritis.

Infectious necrotic enteritis and swine plague sometimes occur simultaneously in an animal, and the pulmonary lesions of swine plague will then be noted in addition to the lesions of enteritis.

Those cases of infectious necrotic enteritis complicated with paratyphoid infections are sometimes difficult to differentiate from the lesions occurring in hog cholera and infectious enteritis. The involvement of the peritoneum is probably more intense in paratyphoid infections and the adhesions are more marked.

Symptoms.—The symptoms of infectious necrotic enteritis are variable, and the intensity of the symptoms manifested is not proportioned to the intensity and extent of the lesions. Hogs apparently in the best of health may reveal lesions indicative of a chronic infectious enteritis on autopsy while swine manifesting the usual symptoms of this disease may show very limited lesions on autopsy. The infection acts more rapidly and is more destructive in some cases and is slow going

and rarely fatal in other cases, but with our present knowledge it does not seem advisable to attempt a symptomatic classification of this disease into acute and chronic types.

Usually the first symptom noted is depression. This disease may affect only a few animals in a herd or a few animals may be affected at one time and they either die or recover and others in the same herd become infected, the disease thus ultimately affecting all swine on a given farm. In other instances practically all of the swine show evidence of the disease at the same time. They are dull and separate themselves from the other swine. Appetite is diminished, although it may not be noted by the caretaker. In some outbreaks the first evidence of the disease noted is the general dullness. The owners will report that a large percentage of the hogs lack activity and appear dull and depressed. As the disease progresses digestive derangements become more evident and are manifested by irregular appetite and diarrhea. The affected individuals at this stage appear unthrifty, have rough coats and arched backs. The fecal discharges are quite fluid and of variable color, depending upon the feed. The affected individuals become emaciated, thin and weak and may die of exhaustion or they may ultimately recover. The temperature varies from normal to 105 or 106 degrees F. during the active stage of the disease, but in the later stages it is not unusual to record subnormal temperatures. In uncomplicated cases, no pulmonary disturbances are manifested.

Course.—The course of the disease is very irregular. In some cases it is of only a few days' duration, while in other instances individual animals may be affected for several weeks.

Diagnosis.—The identification of this disease requires an autopsy of one or more cadavers. The characteristic lesion upon which judgment is based occurs in the intestine and consists of an inflammation in which some of the involved tissue has become necrotic and is adherent to the intestinal mucosa. The finding of these lesions when coupled with a definite history of the outbreak and observation of the leading symptoms—irregular appetite, diarrhea, dullness and variable temperature—is usually sufficient evidence upon which a positive diagnosis can be made.

Differential diagnosis.—Although it is not difficult to make a diagnosis of infectious necrotic enteritis it will require careful consideration to exclude other diseases or identify complications. In differentiating infectious necrotic enteritis from other infections, it is essen-

tial to carefully consider the history and symptoms as well as lesions. Hog cholera invariably has a sudden onset, a large percentage of a herd being simultaneously affected, and anorexia is a prominent symptom; whereas, infectious necrotic enteritis has a relatively slow onset, and the affected animals have irregular appetites. If hog cholera and infectious necrotic enteritis occur simultaneously the history and symptoms would typify hog cholera and it will be necessary to identify the combination by the lesions revealed in autopsy which would consist of petechial hemorrhages in the lung, subserous structures, kidney, bladder and spleen, and congestion of the skin and hemorrhages in various lymph-glands which typify cholera as well as the lesions of infectious necrotic enteritis in the intestinal mucosa and peritoneum.

Swine plague of the septicemic or pulmonary type is relatively common and may occur independently or as a complication of infectious necrotic enteritis. The septicemic form of swine plague has a sudden onset and rapid course. Many animals are simultaneously affected and the lesions consist of submucous and subserous hemorrhages, congestion of the skin and lymph-glands, and in some instances there is pulmonary edema. These clinical and postmortem findings are sufficiently distinctive for the identification of this form of swine plague. If the septicemic form of swine plague and infectious necrotic enteritis occur simultaneously, the history and symptoms would characterize swine plague and the existence of inflammatory necrotic intestinal lesions would identify infectious necrotic enteritis. The pulmonary form of swine plague is characterized by cough and dyspnea in various degrees, sufficiently distinctive from symptoms of infectious necrotic enteritis that diagnosis should not be difficult.

The simultaneous existence of the pulmonary form of swine plague and infectious necrotic enteritis will evidence a combination of symptoms indicating involvement of the thoracic and abdominal organs, but an autopsy will reveal an atypical catarrhal pneumonia in which there is an interlobular infiltration and there may or may not be a fibrinous pleurisy lesion typifying pulmonary swine plague, and in addition there will be found intestinal lesions characterizing infectious necrotic enteritis.

Parasitic pneumonia occurring separately or as a complication of infectious necrotic enteritis is sufficiently prevalent to be given consideration in differential diagnosis. The uncomplicated cases are

characterized by pulmonary symptoms, sufficiently distinctive to exclude infectious necrotic enteritis. A combination of parasitic pneumonia and infectious necrotic enteritis may be identified by the demonstration of parasites in the lung lesions and by the inflammatory necrotic lesions in the intestine.

Paratyphoid infections occur in swine, but the symptoms and lesions produced have not been positively determined, verified and recorded. It is probable that paratyphoid infections occur most frequently in garbage-fed hogs. Accumulation of dark colored blood in the skin and subcutis producing the "blue belly" is probably a characteristic lesion of paratyphoid infection. The spleen is usually extensively enlarged. By a careful consideration of the foregoing paratyphoid infection may be identified.

Intestinal necrobacillosis is characterized by lesions consisting of coagulation necrosis in which the necrotic tissue later becomes caseous. The necrobacillosis lesions are circumscribed yellowish or brownish areas containing a dry, mealy, cheese-like substance emitting a pungent disagreeable odor.

Prognosis.—The prognosis should be guarded. If the infection is relatively mild the percentage of deaths will be small but the loss of condition of the affected animals may produce an extensive economic loss.

Control.—Sanitary requirements are frequently ignored by the hog feeder and breeder. Although infectious necrotic enteritis may occur in swine that are maintained in clean pens and properly housed it is much more prevalent in swine that are kept in mud and filth. There is a tendency for the larger feeders to keep too many hogs in one lot, a method that is conducive to the rapid spread of any infectious disease. Men who are most successful in swine husbandry carefully watch their herds and the first indication of any defect or disease is sufficient cause for isolation of the affected animal. Quarantine is the first principle in controlling the spread of infection and to be most effective isolation should be absolute. Rigid enforcement of quarantine regulations in the early stages of infectious necrotic enteritis will materially diminish the losses occasioned by this disease. Stocker hogs that have been purchased and immunized at market centers frequently become affected with infectious necrotic enteritis. Shipped in stocker hogs or breeding hogs should be kept in quarantine for three weeks. Slop foods of good quality should be provided for affected animals. They should be kept in comfortable quarters

and the droppings should be gathered daily, disinfected and properly disposed of. All dead animals should be burned or buried sufficiently deep and limed to destroy infection.

Prevention.—The indications are that infectious necrotic enteritis is due to microbian invasion of the intestinal mucosa and to the production of an inflammatory necrotic lesion. It seems probable that the B. suipestifer is the primary causative factor; however, a host of other microbian agents are always present and no doubt are a factor in this disease. In the control of the B. suipestifer, which is probably the specific cause, including the sources of infection and avenues of entrance, the associated microbian agents will be of no consequence. The B. suipestifer, according to recent experiments, does not inhabit the intestine of normal swine; therefore, its presence signifies a carrier or a diseased animal. The organism is eliminated in the fecal discharges, and soils, feed and water become contaminated. Pens, lots, sheds and runs that have been occupied by diseased animals should be thoroughly cleaned and the litter properly disposed of and disinfected before other animals are placed therein. Intestinal parasites predispose to infection with the B. suipestifer, and all swine should be periodically "wormed out."

Various biologic agents claimed to be of value as immunizing agents are available. The B. suipestifer produces an endotoxin and it is probable that an opsonic immunity can be produced by a bacterin made of the B. suipestifer. The reports from the successful use of such a bacterin are found in practically all veterinary journals. Most bacterins recommended for prevention of infectious necrotic enteritis include the B. suipestifer, suisepticus, coli communis, paratyphoid and B. of Gaertner. Such products are usually marketed as "Mixed Bacterin (Swine)." Extensive losses in stock hogs, that had been simultaneously immunized against hog cholera in public markets, have been due to infectious necrotic enteritis. According to reports, the losses in stock due to this disease have been materially diminished by the use of mixed bacterin, administered when the swine are immunized against cholera and the losses were reduced to a minimum in those shipments in which a second injection of the mixed bacterin was given five to seven days after the first. The administration of bacterin to all exposed swine on a farm is advisable, and some practitioners claim to have produced beneficial results by the use of bacterin as a curative agent.

Treatment.—Affected swine should be provided with easily digest-

ible slop foods and placed in comfortable quarters. Intestinal antiseptics are indicated. The antiseptic selected should be such as can be administered in the slop. Copper sulphate is probably as efficient as any other and has the advantage of being relatively cheap. From one to two-dram doses may be administered daily in the slop or if the affected animal does not eat, the copper sulphate should be given in capsules. Some practitioners advocate the use of mixed bacterin, repeating the dose in five to seven days.

Necrobacillosis

Necrobacillosis is a name for a group of diseased conditions caused by the Bacillus necrophorus and characterized by inflammation and necrosis. This condition is of common occurrence in one form or other in various locations in the United States and in other countries. The state of Colorado has suffered extensive losses from necrobacillosis; in fact, according to Glover, the losses from this disease in that state prior to 1912 were greater than the losses from cholera. The disease occurs sporadically, enzootically, and rarely as an epizootic.

Etiology.—Various insanitary conditions may be predisposing factors. Diminished resistance of the tissues, as catarrhal enteritis, injury of the skin and buccal mucosa, favors infection.

The Bacillus necrophorus is the specific cause of necrobacillosis. This microorganism is universally distributed, though the intestinal tract of swine may be its natural habitat. The Bacillus necrophorus is pleomorphic, but usually occurs in long threads in cultures and in the invaded tissues. It contains granules, particularly in old cultures. It is nonmotile and does not form spores. It is a strict anaërobe and grows well in serum agar, bouillon, and milk. A pungent, disagreeable odor is evolved from the cultures, and may also be recognized in the lesions. It stains readily with practically all of the aniline dyes but not with Gram's stain.

The Bacillus necrophorus produces disease by products that it elaborates and eliminates into the tissue. This microorganism is pathogenic for practically all animals; but as a rule it is only a secondary invader, the tissue resistance having been diminished by previous disease process or by injury. Inoculations of cultures of the Bacillus necrophorus produce necrosis, or abscess formation, in cattle, sheep, swine, and horses.

Source of infection.—The Bacillus necrophorus inhabits the diges-

tive tube of swine and, less frequently, the digestive tube of other animals; therefore the microorganism is found in the feces of practically all animals. Soil, yards, pens, floors—in fact, practically all of the surroundings—easily become contaminated with fecal matter, and the disease may be obtained from anything that has been contaminated with feces. Infection is usually indirect, although the Bacillus necrophorus may be transmitted from an affected to a healthy animal by contact.

Channel of entrance.—This infective agent may be successfully introduced into the susceptible swine in food or drink by way of the mouth, upon inhaled dust particles by way of the respiratory organs, or it may be introduced through abrasions of the skin, and, more rarely, into the genital organs during copulation.

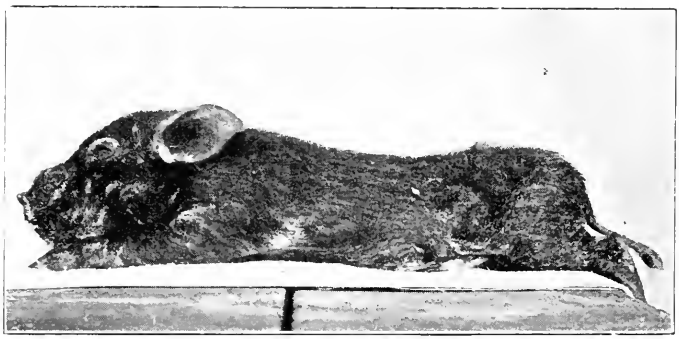

Fig. 93. NECROBACILLOSIS.

Lesions.—The Bacillus necrophorus is capable of invading practically any tissue of the body, and the lesions produced so closely resemble each other than one general description will suffice. The lesion consists of a coagulation necrosis, the necrotic material later becoming caseated. The local lesion has a tendency to become larger, due to the infiltration of the surrounding tissue with the products of the Bacillus necrophorus. The infection, and therefore the lesions, may occur elsewhere in the body, due to metastasis. There may be general emaciation due to absorption of the products of the Bacillus necrophorus, and tissue destruction.

The local specific lesion is a sharply circumscribed yellowish or brownish area containing a homogeneous, dry, mealy, or cheese-like substance from which a pungent and disagreeable odor emanates.

Microscopic examination of a section of one of these areas reveals a central mass of tissue débris composed of disintegrating and destroyed cells which do not stain. Surrounding the necrotic area is a zone made up of leukocytes, damaged tissue cells, and considerable numbers of Bacillus necrophorus filaments arranged in bundles. The surrounding tissue evidences a severe reaction by hyperemia, and the presence of large numbers of leukocytes and a few Bacilli necrophorus.

Necrobacillosis assumes many different forms, the most common of which are necrotic stomatitis, enteritis, rhinitis, pneumonia, hepatitis, splenitis, vaginitis, and dermatitis.

NECROTIC STOMATITIS

Necrotic stomatitis is probably the most common form of necrobacillosis. It is of frequent occurrence in suckling pigs.

Lesions and symptoms.—The inflammation usually begins at the margins of the gums. The successive changes in the affected areas are as follows: The surface is red or bluish red, becomes tumefied, is very sensitive, and bleeds easily. Two or three days later the area becomes yellowish white or even brown in color and of a mushy consistency, and usually sloughs, leaving an eroded surface which is covered by a coagulated necrotic tissue and appears as a diphtheritic membrane. The surrounding tissue becomes red, tumefied, and sensitive. The disease process gradually extends and ultimately becomes confluent, forming large eroded areas. A similar process frequently affects the lips simultaneously.

The affected pigs frequently attempt to nurse, but the gums are so sensitive that they obtain little nourishment. Pigs may transmit the disease to the teats of their mother by nursing. There is salivation and champing of the teeth. Upon inspection the foregoing lesions are observed and a peculiar disagreeable odor is also noted which may permeate the air and be recognized at a considerable distance. As the disease progresses the discharged saliva becomes bloody and contains shreds of tissue.

The course of this disease varies from a few days in the acute form to several weeks in the chronic form.

Diagnosis.—The identification of necrotic stomatitis is not difficult if the typical necrotic lesions are observed and the peculiar offensive odor is recognized.

Treatment.—In the early stages the treatment of the cases may be

successful, but in the advanced stages the disease usually proves fatal regardless of treatment. The most successful treatment consists in washing the oral cavity and applying upon the eroded areas one-percent solutions of silver nitrate or three-to five-percent solutions of zinc chlorid. Local treatment should be repeated frequently.

NECROTIC ENTERITIS

Bacillus necrophorus infection may occur in the intestinal mucosa and produce lesions similar to those in necrotic stomatitis.

NECROTIC RHINITIS

This condition is usually associated with necrosis of the snout and frequently also of the lips, and is of rather common occurrence in small pigs. It is one of the conditions that constitutes the disease called sniffles. Sniffles also includes infectious rhinitis, particularly those cases in which deformity of the snout and nasal cavities occurs, and those cases of rickets in which there is involvement of the nasal and facial bones, causing more or less deformity.

Lesions.—Necrobacillosis of the schneiderian mucous membrane and the snout is characterized by the same lesions that are characteristic of necrotic stomatitis, except that here bone tissue is frequently involved, resulting in fibrous proliferation and deformity of the parts.

Symptoms.—The affected animals have a tendency to root considerably in their food, but they eat little. The characteristic symptom consists of a peculiar blowing noise. The animals sneeze, and occasionally expel bloody material containing shreds of tissue. The snout becomes enlarged and the face bulging, this condition frequently being called elephant head.

Treatment.—It is not possible to treat these cases efficiently because of the difficulty of applying medicaments to the lesion and further because of the destructive changes in the bones of the nose and face.

NECROTIC PNEUMONIA

Necrotic pneumonia is frequently an associated condition of necrotic rhinitis, the infection taking place by the inhalation of necrotic particles from the nose.

Lesions.—The same general coagulation necrosis type of lesions that characterizes necrobacillosis is observed also in necrotic pneumonia.

Symptoms.—Manifestations of the disease are similar to those of

croupous pneumonia, though evidence of septic intoxication is more pronounced than in the latter. The very offensive odor of the expired air characterizes pulmonary necrobacillosis.

Treatment.—Treatment other than providing good, nourishing food and sanitary surroundings is of little or no avail.

NECROTIC HEPATITIS

Hepatic necrobacillosis is not of common occurrence, but some cases have been observed. It is usually secondary to necrotic enteritis, the infection passing through the portal system and metastasizing in the liver.

Lesions.—The lesions consist of sharply circumscribed grayish-white areas varying in size from that of a pinhead to a silver dollar. These areas may be surrounded by a fibrous capsule. The density or consistency of the lesion depends upon its age. It may be of the same consistency as the surrounding liver, it may be dry and mealy, or, if the animal recovers, it may become calcareous. These areas may not cause any irregularity in the size or shape of the liver or the lesion may assume the nodular form, the nodules projecting from the surface of the liver. The surface nodules have a raised border and a depressed center, and are quite characteristic in appearance.

Symptoms.—No definite symptoms have been attributed to hepatic necrobacillosis other than general digestive derangement. These cases are diagnosed at autopsy.

Treatment.—The location of the lesions and the nature of the process practically eliminate the possibility of successful treatment.

NECROTIC SPLENITIS

Splenic necrosis is a rather common condition in swine. It may be caused by other agencies than the Bacillus necrophorus, but from investigations thus far conducted it appears that the most frequent cause of necrosis of the spleen is the Bacillus necrophorus. This condition is commonly associated with the use of a contaminated hog-cholera virus. The infection is carried in the blood to the spleen.

Lesions.—The necrotic centers in the spleen are usually encapsulated, the density of the capsule varying with the length of duration of the process. As a rule, the centers are in the form of nodules. They are of a grayish-white color and usually have a depressed center and a raised border. In size these foci vary from masses half an inch in

diameter to irregular masses from one to three inches in diameter. There may be only a few centers, but usually there are many; in some instances so numerous are they that it is difficult to identify any normal splenic tissue. The non-encapsulated lesions are dirty-white centers and give the appearance of having been painted in the splenic tissue.

Symptoms are indistinct, and treatment cannot be applied.

VAGINAL VULVAR AND PREPUTIAL NECROSIS

Necrotic vaginitis and vulvitis occur, but are not prevalent. Infection probably gains entrance through abrasions produced at the time of parturition or copulation, or, more rarely, by means of accidental traumatic wounds. The lesions consist of tumefaction, redness, and sensitiveness, followed by necrosis. The necrotic tissue may become desiccated and slough, or it may be converted into a mushy mass. The erosion of the vulva may destroy the vulvar tissue and even the anal tissue. Dense masses of fibrous tissue usually develop in the perinecrotic zone, which later cicatrize and produce various distortions of the vulvo-anal structures.

Infection of the prepuce may gain entrance through abrasions produced by inflammation that has resulted from irritation from urine, screw worms, or similar causes. Infection may also be favored by traumatic injuries of various kinds. The lesions are of the same general nature as those observed in vulvitis. The prepuce occasionally becomes entirely destroyed, and sometimes the penis becomes involved.

The vulvar and preputial lesions sometimes interfere with, and even inhibit urination, resulting in retention of urine. In such cases in the male the sheath may become enormously distended with urine.

Treatment.—Treatment is confined to the local application of some penetrating disinfectant. Those lesions that become necrotic are removed in order that the disinfectant may have free access to the invaded tissue. Adhesions and other conditions that obstruct the urine should be corrected, at least temporarily, in order that the urine may be voided and thus uremic poisoning prevented.

NECROTIC DERMATITIS

Necrotic dermatitis, aside from the type affecting the lips, vulva, and prepuce, is sometimes encountered. It is of most frequent occurrence in young pigs, and affects any portion of the body. Infection

of the skin by Bacillus necrophorus is probably possible only through abrasions and wounds.

Lesions.—The lesions are practically the same as in other superficial necrobacillosis. Not infrequently large areas slough, leaving irregular denuded surfaces. This condition is frequently fatal, particularly in those cases having extensive infection where absorption of the products is sufficient to insure systemic disturbance.

Treatment.—Treatment consists of removing necrotic tissue and applying some antiseptic that will readily penetrate the infected area. The treatment must be persistent, as relief cannot be obtained from one application.

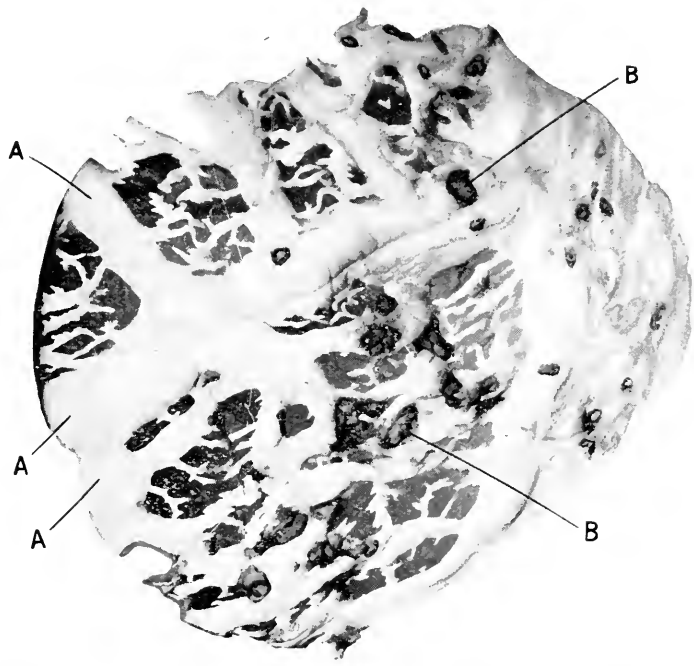

Fig. 94. FAT NECROSIS (Omentum). A, normal fat; B, areas of necrosis.

UNUSUAL FORMS OF NECROBACILLOSIS

Necrobacillosis sometimes occurs in the various structures of the eye. This is a serious condition, as the agents used in combatting the Bacillus necrophorus have to be used in such concentration that they are injurious to the eye. The usual outcome of ocular necrobacillosis

is destruction of the eye, and if both eyes are involved the animal becomes blind and usually has to be destroyed.

Necrobacillosis as a sequel of castration has been previously discussed.

Necrobacillosis is a disease that may affect practically any and all tissues of swine and is of considerable economic importance. The most common forms of the disease are necrotic stomatitis and enteritis, and necrosis of the sheath.

Paratyphoid Infection

Paratyphoid bacilli, particularly the one designated as paratyphoid B., has been isolated from a disease condition in swine. In some cases this bacillus was obtained in pure cultures direct from the lesions of swine that were in the advanced stages of disease when destroyed for autopsy purposes.

This infection occurs primarily in swine in feed lots, particularly when the lots are overstocked and are in an insanitary condition. The disease in which the paratyphoid B. is associated may be acute or sub-acute and the affection has been observed in feeder swine that had been simultaneously immunized a month or six weeks prior to the outbreak.

The lesions noted on autopsy in these cases consisted of a marked enlargement of the spleen and an enteritis. There may also be tumefaction and infiltration of the lymph-glands. In some of these cases there was also observed a blue or purple discolorization of the skin on the ventral surface of the abdomen. Very limited hemorrhages were observed in the mesenteric lymph-glands in one or two cases. The blood is usually dark in color and does not coagulate readily.

The first evidence of the disease is usually inappetence or diminished appetite, the affected animal appearing depressed and having little tendency to move. There is constipation at the onset, but it is usually succeeded by diarrhea. There is rise of temperature and there may be congestion of the skin. In the acute type of the disease the affected animals usually die within two days after the onset. In the subacute or chronic form the affected animals may linger for several days and may ultimately recover, although they are apparently permanently damaged. The swine in the subacute type rapidly emaciate and become weakened.

The field diagnosis of this condition is difficult and the positive

diagnosis should be done by laboratory procedure. The enlarged and engorged spleen is apparently the outstanding lesion.

Treatment.—Treatment in the acute attacks has not proved successful. A bacterin made from the paratyphoid B. has been reported as valuable in preventing this disease, and according to some this bacterin has been successfully used in the subacute form of the disease.

Salmonellosis

Salmonellosis is the name of a disease of swine caused by the B. suipestifer. The occurrence of a disease caused by the B. suipestifer has been experimentally demonstrated; however, the actual occurrence of the disease as a distinct entity is difficult to identify. It is possible that the condition now designated as infectious necrotic enteritis and attributed to various microbian agents will be demonstrated to be salmonellosis. The significance of the B. suipestifer is not fully appreciated by practitioners and many investigators, but it is no doubt an important factor in the diseases of swine.

Malignant Edema

Malignant edema is a specific infective disease caused by the Bacillus edematis maligni. Pasteur described this disease in 1878 and it was later investigated by Koch and others.

This disease is relatively common in swine, although reports of cases in literature are rare, probably because of the failure to recognize the disease. Porcine malignant edema occurs most frequently as a sequel to immunization with anti-hog cholera serum, castration or other surgical operations. Cases of malignant edema occurring in recently immunized swine have been observed in which 50 per cent of the immunized swine died. The disease has also been observed in swine that had been hyperimmunized for serum production and it has also been reported to occur in virus pigs in serum establishments. Some sporadic cases of malignant edema have been reported or at least the B. edematis maligni were isolated from lesions.

Etiology.—The specific cause of this disease is the B. edematis maligni, an anaerobic spore-bearing microorganism. These microorganisms are found in the soil and also occur in the digestive tract of some animals. They are distinct bacillary microorganisms when isolated from the tissue of an affected animal, but they grow into long filaments after the death of an infected animal and in artificial culture media:

The B. edematis maligni varies in length from 2 to 4 microns, although the filaments in culture media may become 15 microns in length. These microorganisms average about one micron in diameter. They are freely motile and stain readily with the ordinary aniline dyes. Spore formation causes a slight bulging of the bacillary walls. The spores are very resistant to external influences.

These organisms are strictly anaerobic. They grow at room temperature on any ordinary culture medium. Gelatine is liquefied and stab cultures in agar show development of gas.

Predisposing causes are of prime importance in the occurrence of malignant edema in swine. The injury incidental to the injection of serum or virus in the simultaneous immunization provides a favorable field for the development of the bacilli which may be introduced with the serum of virus but are more frequently carried into the tissues by the needle from the contaminated skin or may gain access through the needle puncture. Insanitary pens, lots and sheds favor the development of malignant edema in swine. Swine that are filthy or muddy should not be immunized because of the danger of infection of the needle puncture with the bacillus of malignant edema.

Operative wounds incidental to castration, scrotal hernia, ablation of mammary glands and cesarean section should be properly protected as the surrounding tissues have a diminished resistance due to the operative procedure, otherwise infection and the development of malignant edema may occur. The ringing or ear-marking of swine also provides a favorable field for infection. Parturition is an important predisposing factor and it is probable that many of the cases of so-called septic metritis are malignant edema.

Source of infection.—Infection with the B. edematis maligni is obtained most frequently from soil or fecal discharges. Serum or virus may be contaminated at the biologic establishment producing it, but is more frequently contaminated in the field by dust gaining access to the serum or virus containers. Some outbreaks of malignant edema have been traced to syringes that have not been sterilized previous to use. In many instances the recently immunized or castrated swine have not been placed and maintained in clean quarters by the owners, as instructed by the veterinarian and the needle punctures or operative wounds have become contaminated and infection with the B. edamitis maligni resulted.

Channe's of entrance of infection.—Malignant edema is practically

always a wound infection disease; therefore infection in the majority of instances gains entrance through injuries or wounds.

Lesions.—The first manifestation of wound infective malignant edema consists of a marked tumefaction of the surrounding structures. The tumefied tissues will be found edematous and deep-seated gas may be detected by palpation. If the tumefied structures are incised a bloody serum having a fetid odor will escape. The extent of the swelling varies and depends upon the density of the tissue and the virulence of the infection. In some cases the tumefaction extends some distance from the infected wound. By autopsy these tumefactions are found to be a mass of infiltrated disintegrated tissue, having a very offensive odor. The subcutis and muscle are extensively infiltrated with a semi-solid gelatinous material. The related lymph-glands are usually tumefied and edematous. The visceral organs usually have a parboiled appearance.

In cases of malignant edema succeeding castration or other operations which permit of extension of infection to the peritoneum, the lesions consist of peritonitis in which the peritoneal blood-vessels are engorged and there are varying quantities of a serosanguineous fluid in the peritoneal cavity. The connective tissues in the inguinal region are usually slightly infiltrated. The spleen may be dark in color.

Metritis due to the B. edematis maligni is characterized by a deep red color of the uterine mucosa and a bloody effusion into the uterine cavity. The uterine walls are infiltrated and the entire uterine structure is more or less degenerated and emits a foul odor.

Symptoms.—The symptoms evidenced by wound infective malignant edema are: depression, disturbance of locomotion, inappetence, edematous swellings and rise of temperature. These symptoms usually develop in from twelve hours to two days after the wound is infected. In peritoneal malignant edema the affected animal has a "tucked up" appearance and manifests pain when the abdomen is palpated. There will be rise of temperature and inappetence. Septic metritis is evidenced by an arched back, bloody discharge from the genitals, high temperature and anorexia. Malignant edema is fatal in a large percentage of cases. The course of the disease is short; the animals succumb on the second or third day.

Treatment.—Treatment of malignant edema in swine has not proved successful. A preventive vaccine has been experimentally demon-

strated to protect against natural infection in other animals and probably would be equally valuable in swine.

This disease can be prevented by sterilization of instruments, the proper after-care of immunized swine and swine that have been operated upon.

Anthrax (Charbon)

Anthrax is a specific infective disease caused by the B. anthracis and characterized by changes in the blood, spleen and lymph-glands.

This disease prevails in some sections of the country, but occurs more frequently in mules, horses, cattle and sheep than in swine. Many cases have been reported in swine from different localities, but fortunately the outbreaks have been confined to a few animals, or at least to one farm. Porcine anthrax usually occurs in swine that have been fed the carcass of an animal dead of anthrax.

Etiology.—The specific cause of anthrax is the B. anthracis. The B. anthracis is a rod-shaped non-motile bacterium averaging about 4 microns in length and 1 to 1¼ micron in diameter. This bacterium is characterized by relatively square or concave ends when obtained from lesions. They stain readily with ordinary aniline dyes. Oval spores form in the center of the rods. Spores of the B. anthracis are very resistant to external influences, to chemical disinfectants, and to the usual means of sterilization.

Fig. 95. BACILLUS ANTHRACIS. (From Hutyra & Marek.)

The B. anthracis is aerobic and grows readily on any ordinary culture medium at body temperature. Long threads of filaments are common in cultures of B. anthracis.

Source of infection.—The most common and usual source of infection from B. anthracis in swine is from the discharges and carcasses of animals dead of anthrax. More rarely infection may be obtained from contaminated water, feed or soil.

Channel of Entrance.—The usual channel of entrance of the B. anthracis in swine is the digestive tract in feed or water.

Lesions.—Anthrax in swine is usually localized in the beginning, although it frequently becomes generalized or of the septicemic type

before death. The lesion in the beginning consists of a tumefaction in the sub-maxillary or pharyngeal region. The extent of the tumefaction varies. In some cases the swelling may be so extensive that the eyes are closed, the ear pendulous and the entire head distorted.

The characteristic lesions of generalized anthrax are: The blood appears like tar and does not coagulate readily. Hemorrhages of varying size occur in practically all tissues. The lymph-glands are tumefied and edematous. The spleen is enlarged and the splenic pulp soft. All of the foregoing lesions vary according to the length of duration of the disease.

The local lesion of anthrax in swine is usually located in the pharyngeal region and consists of a marked serous inflammation with infiltration of quantities of serogelatinous exudate, causing extensive tumefaction. The mucosa of the pharynx, larynx and sometimes the trachea, mouth and nares show marked inflammatory changes.

Symptoms.—Swelling in the submaxillary or pharyngeal region is usually the first symptom evidenced. The affected swine are dull and listless. The appetite is usually normal in the beginning. The ocular mucosa is congested. As the disease progresses deglutition becomes difficult and there may be difficulty in breathing. In some cases the animals will sit on their haunches and gasp and may die of suffocation.

This disease runs a rapid course, the affected animals rarely living over 24 hours after the first symptoms appear.

Treatment.—Anthrax in swine usually occurs in animals that have been fed carcasses of animals dead of anthrax or waste from packing houses or tanneries and therefore can be prevented by prohibiting food from those sources. The treatment of affected animals with anti-anthrax serum has proved of value in other animals and is worthy of trial in swine. Exposed animals should be immunized by the anti-anthrax serum. Carcasses of swine dead of anthrax should be burned and the premises cleaned and disinfected.

Tuberculosis

Tuberculosis is a specific infective disease caused by the tubercle bacillus and characterized by the formation of tubercles.

History.—Tuberculosis has been recognized from the remotest time in the history of man as a prevalent disease of mankind. In 1689 the tubercle was identified by Morton as the typical lesion of tuberculosis. Various investigators have given additional knowledge on the subject

of tuberculosis. In 1865 Villemin proved the infectiousness of the disease, while Koch discovered the tubercle bacillus in 1882, thus establishing firmly the theory of the infectiousness of tuberculosis. The study of tuberculosis has been advanced and its recognition clinically has been made possible by the use of tuberculin, which was discovered by Koch in 1890. In 1901 he startled the scientific world by announcing at the tuberculosis congress in London that human and bovine tuberculosis were separate and distinct diseases, a statement that was responsible for the organization of different scientific bodies that, after careful investigation, reported that although there may be some slight difference between the tubercle of human and bovine origin, the disease produced is the same and that the disease is intertransmissible between animals and man.

Occurrence.—Tuberculosis is becoming very prevalent among swine. This is due to the fact that the dairying industry is becoming more extensive and the by-products of milk are used for swine feed. A relatively large percentage of dairy cattle is tuberculous, and the infection gains entrance to the milk on filth that is contaminated with infected discharges, such as saliva and feces. The organism may also be eliminated direct from the mammary gland into the milk.

Swine from some sections of the United States have been found by experience to be so extensively tuberculous that some packers will buy them only subject to post-mortem inspection.

In Germany from 2.46 to 2.81 per cent of swine slaughtered at abattoirs are condemned on account of tuberculosis. The disease is very prevalent in Belgium, France, Norway and Sweden, and procine tuberculosis is a common disease in the British Isles. According to the annual report of the Bureau of Animal Industry for the fiscal year of 1911, 29,920,260 carcasses of swine were inspected in abattoirs, and of that number 31,517 carcasses and 870,361 parts were condemned on account of tuberculosis. And, for the fiscal year ending June 30, 1919, 44,398,389 hogs were slaughtered at official establishments, of which 65,838 were condemned, and tuberculosis in some degree was found in 4,103,377, or over 9 per cent of the 44,398,389 swine slaughtered were affected with tuberculosis. The disease is becoming more extensive in swine in the United States and should receive more consideration than it does, as the economic loss annually is enormous.

Etiology.—The cause of tuberculosis is the tubercle bacillus or the Bacillus of Koch. It is a rod-shaped organism from 1.5 to 4 microns

long and .3 to .5 micron in width, and is usually curved or slightly bent. It may contain granules or the body may be uniform. It is nonmotile and does not form spores. This organism is covered with a waxlike substance which renders it more difficult to stain than ordinary bacteria, but after the organism has been stained, which can be accomplished by applying steaming carbolfuchsin for five minutes, it retains the stain even when subjected to the action of acids; for this reason it has been called an acid-fast bacterium. It is an aerobe, and

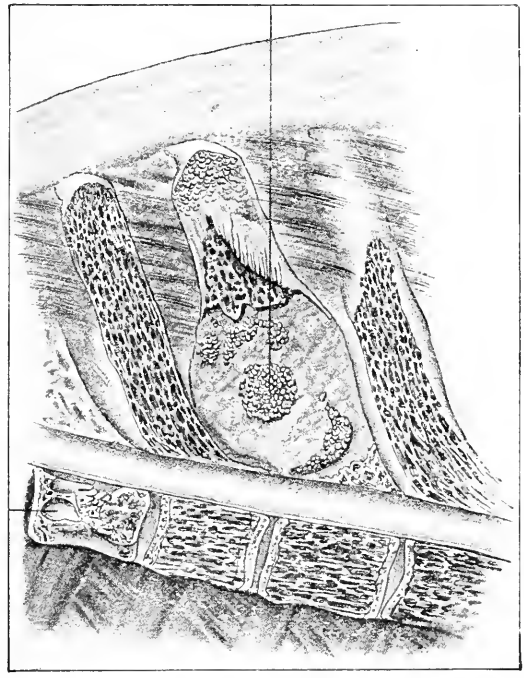

Fig. 96. Vertebral tuberculosis in the hog. (Ostertag.)

grows with relative slowness. It grows luxuriantly in egg albumen culture medium, and fairly well on glycerine agar and in glycerine bouillon. Tubercle bacilli from different sources manifest different cultural characteristics, and on this basis some have claimed four varieties of tubercle bacilli, namely, human, bovine, avian, and reptilian. The bovine and human types have been encountered in swine.

The tubercle bacilli are very resistant to external injurious influ-

ences. This resistance is probably due to the waxy coat they possess. Direct sunlight destroys them when freely exposed for twenty to thirty minutes, but they retain their vitality and virulence for from ten to twenty days when exposed to diffuse daylight. When desiccated and not exposed to light they may retain their virulence for four months or even longer. In decomposing tubercular tissues they remain virulent for a long time. In milk they retain virulence for ten days. Dry heat at 212 degrees Fahrenheit destroys them in one hour; moist heat at the boiling temperature will destroy them in fifteen minutes. They are also destroyed by chemical disinfectants, the length of time for exposure depending upon th concentration of solution and the nature of the tissue or discharge incorporating the bacilli. Gastric juice does not destroy the tubercle bacilli, and bile has little or no injurious effect upon them.

The inoculation of healthy, susceptible animals with virulent bacilli produces tuberculosis, the extent of the lesions produced depending upon the virulence of the bacilli injected and upon the resistance of the inoculated animal.

Source of infection.—Tubercle bacilli are eliminated from the affected animals, at least when there are open lesions in organs, the secretions or excretions of which pass to the outside world. Thus the tubercle bacilli are eliminated in the feces from animals having tuberculous ulcers of the intestinal mucosa. Open tuberculous lesions of the respiratory tract would permit of the elimination of the tubercle bacilli in the discharge from the air tubes and also in the feces, for the chances are that the pharynx would become contaminated by the pulmonary or tracheal discharge and this infection would be carried with food or drink and ultimately pass from the body in the feces. Tubercle bacilli from lesions in the liver or pancreas may also be eliminated in the feces.

Tubercle bacilli from open tubercular lesions of the urogenital organs are eliminated in the urine, seminal fluid, or other discharges from these organs. Infection is directly eliminated from open, cutaneous, tuberculous lesions, and tubercle bacilli may be eliminated in the milk, especially if tuberculous lesions exist in the mammary gland.

The dissemination of tubercle bacilli in the body and the possibility of their elimination through any channel is facilitated by leukocytes. Thus tubercle bacilli in the lung may be incorporated and retained by leukocytes that are later eliminated by the mammary cells, and the

milk become infected even though the mammary gland contain no tuberculous lesions.

From the foregoing it is evident that any of the discharges of tuberculous animals may contain the tubercle bacilli. In the United States and in practically all other countries tuberculosis of cattle is prevalent, particularly among cattle used for dairy purposes.

The most frequent source of porcine tuberculosis is from tuberculous cattle. Swine become infected from the infected cow's milk, feces, nasal discharges, and the carcasses of tuberculous cattle that are given them for food. A limited number of swine become infected from garbage that contains the human tubercle bacilli. This has been especially observed in swine fed upon garbage from tuberculosis sanitaria, or hotels. An occasional case of uterine, ovarian, or testicular tuberculosis is the result of direct infection by copulation. It is pos-

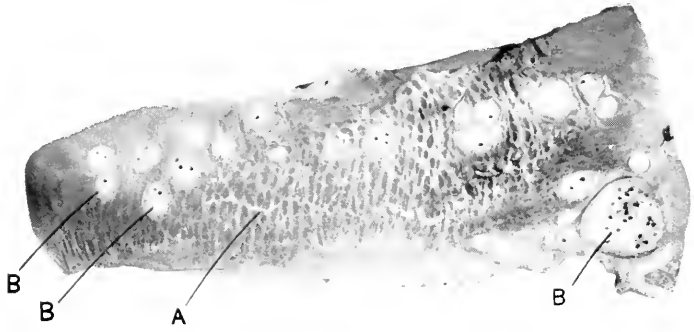

Fig. 97. TUBERCULOSIS OF THE TONGUE. A, normal muscle; B, tuberculous lesions; this is a rare condition in swine.

sible that infection may be transmitted in the exhaled air from infected to healthy swine.

Channels of entrance.—The most frequent channel of entrance of the tubercle bacilli in swine is the digestive tube, the infection being introduced in food or water. An occasional case may become infected by the inhalation of the bacilli and by direct transmission through the genital organs. Mammary tuberculosis may be the result of cutaneous infection or it may be transmitted from elsewhere in the body.

The transmission of the tubercle bacilli from the mother to the fetus is possible, but it is of rare occurrence. But a weakened condition or susceptibility to the disease may and frequently is transmitted from the mother to the fetus.

Lesions.—The typical initial lesion of tuberculosis is the tubercle which has been aptly defined as a nonvascular nodule composed of leukocytes, endothelial, giant and connective tissue cells, with a tendency for the central part of the nodule to undergo necrosis. There may be a slight variation in the tubercle in different animals, due to variation of susceptibility of the animal and variation of the virulence of the infecting bacilli. The typical lesion may also be materially modified by secondary lesions. Tuberculous lesions may occur in any tissue or organ, but lymphoid tissue is most frequently affected.

The tubercle bacilli and their products are the causative factors in the formation of a tubercle. Having lodged in a tissue favorable for their growth and development, the bacilli begin to multiply and to eliminate products that stimulate the surrounding connective tissue and endothelial cells to increase in number, and at the same time exert a positive chemotactic action upon the leukocytes. In swine there is a very marked chemotactic action and limited stimulation of

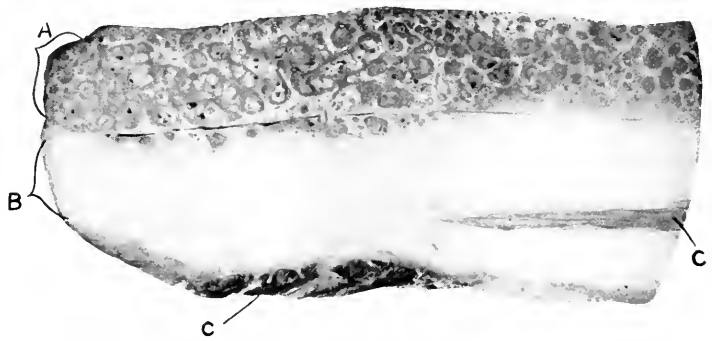

Fig. 98. TUBERCULOSIS OF THE SKIN. A, the skin showing caseo-calcareous lesions; B, subcutaneous fat. C, muscle.

connective tissue. The typical porcine tuberculosis tubercle is largely composed of leukocytes and has little fibrous tissue.

Tubercles grow because of the increased accumulation of leukocytes and the formation of a small quantity of fibrous tissue. The tubercle contains no blood vessels; that is, it is nonvascular, although in the early stages there may be a hypermic zone around the tubercle. This hyperemic zone is the result of irritation in the tissue, the tubercle formation causing a tissue reaction. As the tubercle becomes larger, due to the accumulation of leukocytes on the margin, the central part begins to degenerate.

Porcine tubercular lesions are characterized by enlargement of

lymphatic glands, the formation of tubercles of variable sizes in or upon serous membranes and within the substance of glandular organs, bones, and other connective tissues. The tubercles produce increased density of invaded soft tissues and are, therefore, easily detected except in very recent infection. The tubercular nodules in the early stages present about the same color as the surface of the tissue invaded. In sectioning the tubercle the central portion is caseous and slightly yellow, or fibrous and white. Sometimes there is a combination of both conditions, and occasionally the tubercles contain calcareous granules. The central portion of porcine tubercles rarely contains liquefied necrotic tissue.

Microscopically, porcine tubercular lesions are always cellular in the beginning, the cellular tubercles being fairly constant in structure, regardless of the tissue in which they occur. The center is at first represented by a mass of lymphoid cells, the other cellular elements occurring as the tubercle develops.

Necrosis, or fibrosis, succeeds the cellular stage in the porcine tubercular lesion. Necrosis of tubercles is probably the result of the activity of virulent bacteria or the low resistance of the infected animal. The necrotic center may be surrounded by a cellular zone (lymphoid and endothelial cells), or it may be surrounded by fibroblasts. The necrotic material is invariably caseated and later becomes calcified.

Fibrous lesions vary from the formation of small quantities of fibrous tissue to dense fibrous centers. They are probably produced by bacteria of low virulence, or occur in animals having a marked resistance. The central portion of the fibrous lesion may become calcified.

The so-called arbor vitæ gland is a fibrous center in which the fibrous tissue is arranged similarly to the trunk and branches of a tree, hence the name. In the hog, this lesion is observed in the cervical lymph nodes. The Bacterium tuberculosis has been demonstrated in about thirty per cent of arbor vitæ glands.

The lesions of porcine tuberculosis are in brief either cellular, necrotic, and calcified tubercles, or cellular, fibrous and calcified tubercles. The lesion is always nonvascular, as in other animals.

Tubercular lesions are most common in the digestive viscera. The liver and spleen frequently contain caseous nodules.

Pulmonary porcine tuberculosis manifests itself either by a few or many cheesy foci or by a few large centers. There may be a general caseous pneumonia associated with more or less pleurisy.

Tubercular involvement of the nervous tissue occurs in swine, but is relatively rare. One case has been observed in which a tubercular center occurred in the cerebral tissue. Tuberculosis of the meninges may be local and circumscribed or diffuse and quite general.

Osseous tuberculosis is of common occurrence in swine. It is found especially in the vertebræ.

Symptoms.—Tuberculosis is essentially a chronic disease. The onset is usually so insidious that no abnormality is suspected, and the usual clinical examination of swine is not sufficient to predicate a diag-

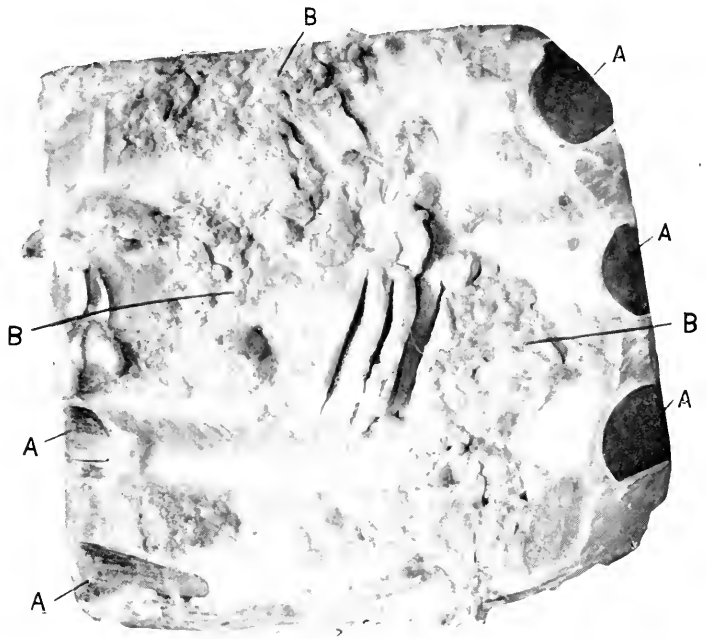

Fig. 99. TUBERCULOSIS OF THE PLEURA. A, rib; B, masses of tubercles.

nosis because the symptoms are so indistinct. Lymph-gland involvements result in tumefaction. The enlarged glands are not pathognomonic of tuberculosis.

Tubercular invasion of the digestive organs produces indigestion. The digestive derangements develop slowly and usually only in young pigs. They become unthrifty and emaciated as the disease progresses.

Pulmonary tuberculosis is evidenced by a dry, short, suppressed cough and by some difficulty of breathing. The cough becomes more

aggravated, and the animals become weak and thin and have a rough coat.

Tuberculosis of the brain, or meninges, is not common and the symptoms evidenced will depend upon the location of the lesion.

Osseous tuberculosis is associated with interference of locomotion and tumefaction of the affected bone.

The length of the course of tuberculosis is variable. In young pigs it may produce fatal termination in from two to three months after the onset. Older swine rarely die of tuberculosis, as the disease assumes a chronic form in them and they are usually marketed before the disease has manifested itself clinically.

Diagnosis.—The clinical diagnosis of this disease is practically impossible without the use of the tuberculin test. The lesions may be identified and the disease can therefore be recognized at autopsy.

The intradermal tuberculin test is most applicable to swine. This test is made by the injection into the dermis at the base of the ear of from three to five minims of ordinary tuberculin.* The reaction consists of a dense swelling at the point of injection and becomes most prominent on the second or third day after injection.

The subcutaneous tuberculin test may be used, but it is not as applicable to swine as it is to cattle. The ophthalmic test may also be employed in swine.

Microscopic examination may be made of the various discharges for the purpose of identifying the tubercle bacilli. In making this test it must be remembered that there are other acid-fast bacteria and further that the absence of tubercle bacilli in the preparations examined is not positive proof of the absence of the disease.

Animal inoculations may be resorted to, particularly in cases in which no tuberculin test has been made and there is a dispute as to the nature of the lesions found.

Treatment.—Curative treatment is of no value in porcine tuberculosis. The only rational method is to sell the affected swine subject to the post-mortem inspection findings. In this way some value will be obtained by the original owner, there will be no loss to the packer and no danger to the consumer.

Tuberculosis is a preventable disease and the losses from it could be avoided, or at least materially diminished, by proper control of tuberculosis in cattle. With our present farm methods the eradication of porcine tuberculosis cannot be accomplished until the disease is eradicated in cattle. The judicious use of skimmed milk, including

pasteurizing milk from suspected cows, will materially diminish tuberculosis in milk-fed swine. The tuberculin testing of steers or other cattle and the elimination of all reactors will prevent the introduction of tuberculosis in swine that follow cattle in the feed lots. Cooking of garbage will prevent the dissemination of tuberculosis to swine. Denver garbage is cooked and fed to swine, and the infection of tuberculosis and hog cholera as well is thus eliminated.

Swine Erysipelas

Swine erysipelas is an infective disease of swine characterized by

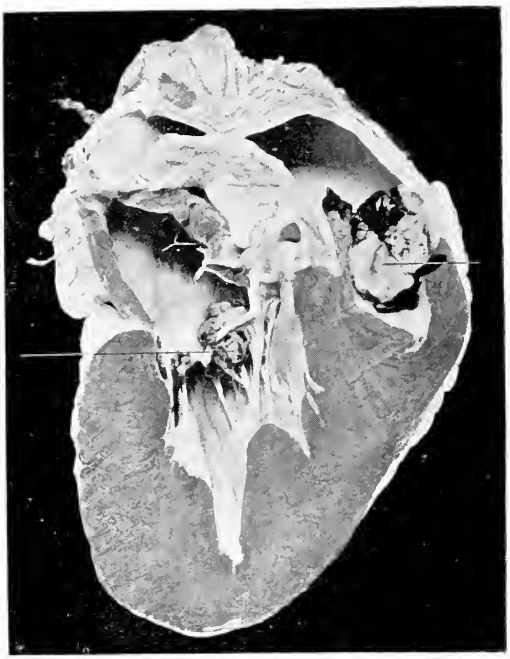

Fig. 100. Proliferations on heart valves following swine erysipelas.

a high temperature, cerebral disturbances and discoloration of the skin. This disease has not been identified in the United States but it has been more or less prevalent in most of the countries of Europe. It is essentially a disease of adult swine and rarely affects swine that are more than three years of age.

Etiology.—Swine erysipelas is caused by the B. of swine erysipelas. This is a slender rod-shaped bacterium from 1 to 2 microns in length

and 2 to 3 microns in diameter. House mice and pigeons may be successfully inoculated with the B. of swine erysipelas.

Period of incubation.—The period of incubation in natural infection is not less than three days.

Lesions.—Swine erysipelas may assume a septicemic form and a less acute form. The septicemic form of the disease is so rapidly fatal that there are no distinct characteristic lesions. In these cases there is usually parenchymatous degeneration of the essential organs. In the less acute cases there is an intense gastro-enteritis which may be hemorrhagic or diphtheritic. There is usually tumefaction and edema of the lymph glands and there may be nephritis, hepatitis and myositis. The spleen is usually engorged with blood. The characteristic lesion consists of red purpuric areas on the ears, around the anus or vulva and on the inner surface of the thighs.

Symptoms.—This disease has a sudden onset. The affected animal is indifferent, refuses food, retches frequently and may vomit, has a high temperature and may evidence disturbances of the cerebral functions. There is marked weakness and a tendency to inco-ordination of the hind legs. The conjunctival mucosa may be injected and the eyelids swollen. There may be grinding of the teeth and diarrhea is usually present.

The characteristic symptom occurs on the skin in various locations and consists of red areas three or four inches in diameter. These areas later become purple and may fuse, forming large patches. Vesicles appear in the purple areas, especially in those that occur upon the ears or facial region. In some cases the discolored skin areas become necrotic and slough. The various symptoms vary in intensity, and in the very acute, rapidly fatal cases and the mild cases the skin lesions may be wanting.

The course of the disease varies from one to ten days and the prognosis is unfavorable. The mortality averages about 60 per cent.

Treatment.—Swine that recover from an attack of swine erysipelas are immune. An immunizing serum may be successfully used in the prevention of this disease, and according to reports the serum is also of value as a curative agent.

Rabies

Rabies occurs in swine, but is not prevalent. It may occur enzoötically, but is much more likely to affect only one animal, or few animals at most, in any one locality.

Etiology.—Rabies is caused by a virus, but the exact nature of this virus has not been determined more than that it is filtrable. Recently it has been successfully cultivated.

Source and manner of infection.—The usual source of rabies in swine is from an infected animal, usually a dog. Rabid dogs meandering through the country occasionally attack swine, biting and thus infecting them.

Lesions.—Gross lesions are absent in swine that have died of rabies. Foreign substances may be found in the stomach, but swine have a habit of consuming almost anything and therefore foreign bodies in the stomach have little significance. Microscopically, Negri bodies are found in the cells of the ammon horn, and also in the cells of the cerebellar cortex. These bodies are the same in swine as in other animals.

Symptoms.—Affected swine usually become excitable and show sexual desire, and they may become vicious and attack other animals or man. They have a depraved appetite, or there may be inappetance. These symptoms will become more aggravated for two or three days, then the animal becomes depressed and paralysis of various groups of muscles appears. The affected animals may be depressed from the beginning, show more or less evidence of paralysis, and finally assume a comatose state prior to death.

Diagnosis.—Diagnosis cannot be made positive by clinical examination, although if the history shows contact with a rabid animal from ten days to four weeks before the symptoms appeared one could diagnose the case as suspected rabies. A positive diagnosis can be made only by the finding of Negri bodies by microscopic examination, or the reproduction of the disease by inoculation of a laboratory animal with a small quantity of the brain tissue of the animal in question.

Treatment.—Curative treatment has always been considered futile. Recently the use of quinine has, according to reports, given good results in cases of rabies in dogs. Other investigators have failed to obtain beneficial results from the use of quinine in experimentally inoculated cases of rabies. If valuable animals are known to have been bitten by a rabid dog it may be given the Pasteur treatment and thus the development of the disease prevented.

Foot and Mouth Disease (Aphthæ Epizooticæ)

This is an acute, infectious, transmissible disease, primarily affecting cattle and sheep. It also affects hogs, goats, more rarely horses, dogs and other animals.

This disease is quite prevalent in some European countries and

it has appeared in the United States on six different occasions: in 1870, 1880, 1884, 1902, 1908 and 1914.

Etiology.—Foot-and-mouth disease is produced by one of the so-called filtrable viruses, which up to the present time has not been successfully cultivated outside of the animal body. The virus exists especially in the serous fluids of the vesicles in the mouth, from which it gains entrance to the saliva and thus to the soil and food from the salivary secretions. The vesicular lesions are also found on the feet and thus the virus also gains entrance to soil, bedding and food, from which other animals can easily obtain infection. There appears to be little doubt but what the virus is eliminated from the body in all excretions. The exact length of time the virus will retain its vitality outside of the animal body has not been determined, but it has been observed that infection will persist in buildings that have not been disinfected for several months. Some outbreaks of this disease have been apparently traced to contaminated hay that had not been in contact with diseased animals for three months or more. Thus infection may be obtained from food, infected premises, hides and in the various animal serums.

In the 1914 outbreak in the United States several centers of infection were undoubtedly established through the use of anti-hog cholera serum that had been made from infected hogs. This latter source is of considerable importance and should entail careful inspection upon the part of the government employes to prevent a distribution of the disease by this means.

The usual channel of entrance of infection is through the abrasion of the buccal mucous membrane, but in hogs the infection is more frequently affected through abrasion of the skin in an interdigital space or around the superior part of the hoof. Such abrasions are no doubt of very common occurrence as they can easily be produced by stubs, sticks and splinters which are very common in the pens where hogs are maintained. Infection can also be introduced upon food stuff, especially by milk from affected cows and thus gain entrance to the lesions to abrasions in the mouth, and as before stated infection may be introduced in serum. Some authorities are of the opinion that the disease may be carried from farm to farm by birds and other carrion animals; hence an absolute quarantine should be maintained on all infected premises.

Lesions.—Foot-and-mouth disease assumes two forms, benign and malignant. As a rule hogs are not as seriously affected with this disease as are cattle, a subacute or benign form being most prevalent in these animals. The principal manifestation of this disease consists of vesicles which develop around the coronary band and in the interdigital spaces. One or more feet may be involved and these vesicles vary in size from a grain of wheat to a pea, and are usually of short duration. The surface of the epithelium ruptures and later desquamates, leaving a denuded surface. The surrounded surface becomes tumefied and hypersensitive. Similar lesions may also be found on the skin of the snout and less frequently upon the buccal mucous membrane. If the animals are maintained in clean quarters the simple uncomplicated lesions will heal in from ten days to three weeks. If the animals are maintained in muddy, filthy pens secondary infections frequently arise and the hoof may slough and the animals die of septic infection. Very rarely a general vesiculo-papular eruption may occur on large areas of the skin.

Symptoms.—The most pronounced symptoms of foot-and-mouth disease in hogs consist in lameness; the principal lesions being found on the feet. The animals have a disinclination to move and because of the soreness tend to assume a decubital position. If the animals are forced to move they will probably walk upon their toes. The lesions in various stages of progress may be observed at this time by inspection. If the disease is of a virulent type there will be systemic disturbances consisting of rise of temperature, inappetence, listlessness or dullness. If the buccal mucous membrane is involved, there will be more or less salivation and disinclination to eat.

Course and prognosis.—This disease usually runs its course in from one to three weeks, although it may progress for a longer period. The disease is ordinarily not fatal if uncomplicated in the hogs, although the financial value of the animals is considerably depreciated because of the fact that they rapidly emaciate.

Treatment.—Thus far no treatment has been found that will curtail the course of the disease. Animals that have had the disease possess an immunity for a short time, probably not longer than six months or a year. The disease is of such a destructive nature in so far as the value of the animals is concerned, that it has always been considered advisable to destroy the animals and disinfect the prem-

ises along with the proper disposal of the carcasses to insure destruction of all available virus.

Because of the extent of the 1914 outbreak in the United States, it is possible that new centers of the disease may make its appearance at almost any time and veterinarians should familiarize themselves with this disease.

TETANUS (LOCK JAW)

Tetanus is a specific infective disease caused by the B. tetani and characterized by spasms of muscular tissue.

Tetanus is not a common disease in swine. It has been observed in suckling pigs and in mature swine but these animals are not as susceptible to the disease as horses.

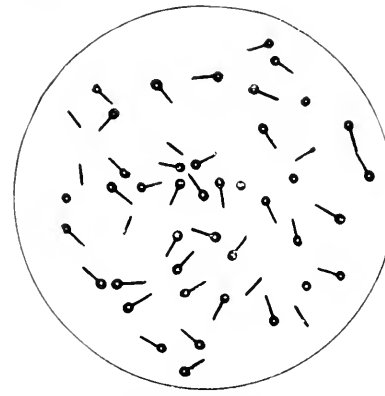

Fig. 101—Bacillus tetani—with spores in various stages of development.

Etiology.—Tetanus is a toxemia and the B. tetani produces the toxin. The B. tetani usually gains entrance through abrasions or puncture wounds and this disease may be a sequel of castration or parturition.

Symptoms.—The symptoms manifested consist of stilty gait, opisthotonos, retracted eye and as the disease progresses there will be spasms of the masseter muscle resulting in socalled "lock jaw." The course of the disease is variable. In some cases the affected animals recover and in others death ensues in from two to four days.

Lesions.—There are no gross lesions that are characteristic of tetanus. Operative or accidental wounds are usually present in the carcass of a hog dead of tetanus.

Treatment.—Prevention of infection is far better than treatment of cases of tetanus in swine. The tetanus bacillus is prevalent in the soil, especially of barn yards and therefore operative wounds should be properly protected. Some practitioners have reported favorable results from the use of from 2000 unit to 5000 unit doses of tetanus antitoxin, repeated every 12 hours until there is relaxation of the muscles. Perhaps lobeline sulphate hypodermically is worthy of a trial in this disease.

CHAPTER XIII

SURGERY AND OBSTETRICS

Castration
Scrotal hernia
Spaying
Removal of mammae
Removal of swirls

Puberty
Estrum
Gestation period
Fecal membranes
Parturition
Dystocia
Cesarean section
Hysterotomy
Hysterectomy
Accidents of pregnancy.

Castration of the Boar

The castration of animals is an ancient practice. This operation in swine is done for economic reasons, the meat of the boar or a stag having a disagreeable odor and in some instances is not palatable. The castration of swine has in general been done by the hog raiser, but the high prices of these animals have been a stimulus to have all such operations done by a competent veterinarian. Although this operation in swine is usually not serious, care should be exercised by the surgeon and the operation aseptically and skilfully done, in order that good results be obtained; otherwise, he will not be employed to do this class of work.

AGE FOR CASTRATION

The exact age that swine should attain before this operation is performed will depend upon surrounding conditions. Generally speaking, swine should be castrated relatively young. It is not advisable to castrate pigs during stormy weather, in early spring, winter or fall, unless they can be placed in clean quarters and properly housed. Neither should this operation be performed on pigs that are in muddy, filthy pens. As in other animals swine should not be castrated if they are affected with some disease or have been exposed to infection. It is usually advisable to place the pigs in a clean pen, giving them a

Fig. 102. Restraint of a large boar for castration. (White's Castration.)

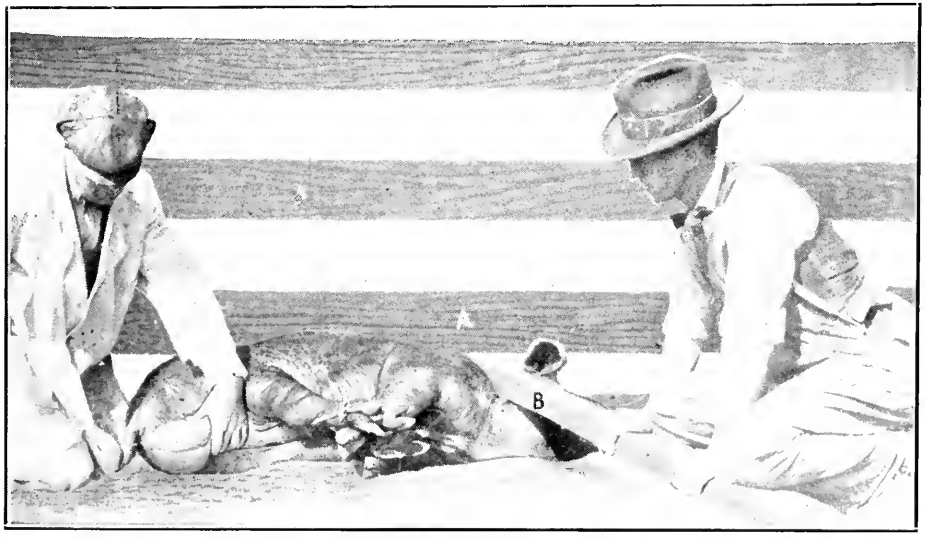

Fig. 103. Restraint for castration. (White's Castration.)

half ration the day before they are to be castrated and withholding feed on the day of castration until after the operation.

INSTRUMENTS

The instruments selected will vary in accordance with the desire of the operator. In selecting instruments those having defects or faulty construction should be rejected. Instruments for castration should contain materials that will permit of sterilization. The usual instruments selected consist of a castration knife, one or more compression forceps and a basin for antiseptic solution.

RESTRAINT

To restrain a pig for castration an assistant should seize it by the hind legs and swing its body between his knees. The assistant thus

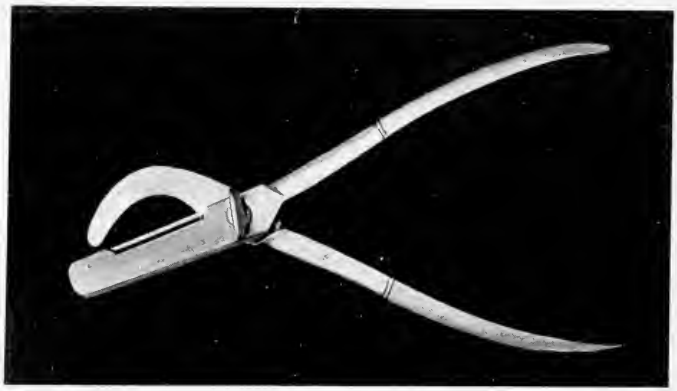

Fig. 104. Swine and sheep emasculator. (White's Castration.)

straddling over the pig's back exposes the scrotum for the operator. Larger hogs may be restrained by seizing the hind leg and ears and throwing the animal on his side, placing one knee on his neck and by flexing the hind leg expose the scrotum. Very large boars may be castrated in the standing position, restraint to be affected by means of a snare.

TECHNIC

The scrotum should be cleaned and washed with some good reliable antiseptic. Some operators recommend the use of a moderately stiff bristle brush to remove the dust and dirt without the application of

liquids, after which the scrotal skin along the line where the incision is to be made is painted with tincture of iodin. A free incision should be made through the skin and dartos. The incision should be parallel to the raphe and extended low enough to insure good drainage. After the testicle has been exposed the cremaster muscle is severed, if it is

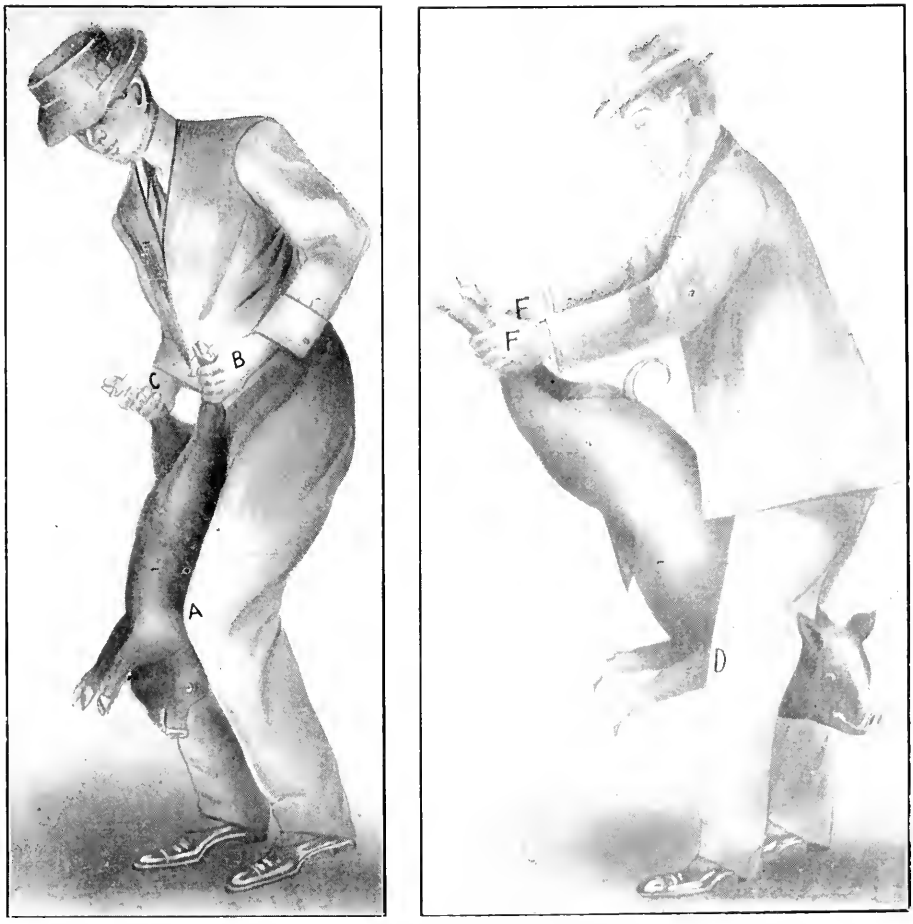

Fig. 105. Holding pig for castration. (White's Castration.)

well developed, and the testicle with the intact vaginal tunic is removed in young pigs by a sudden jerk. The division of the vessels in the spermatic cord by traction tends to prevent subsequent hemorrhage. In old boars it is advisable to use either an ecraseur or emas-

culator to divide the spermatic cord as their use lessens the danger of hemorrhage.

CARE AFTER CASTRATION

When the operation of castration has been completed the wounds should be painted with tincture of iodin and the animals placed in clean quarters. A grass pasture in which there are no mud holes is desirable for recently castrated swine as they are less likely to become infected and are required to exercise. Old boars may evidence colic pains and distress as a result of castration or there may be severe hemorrhage. If such animals are permitted to remain quiet and undisturbed they will usually not require further attention.

CASTRATION OF PIGS WITH MISPLACED TESTICLES

The occurrence of misplaced testicles and cryptorchidism is relatively common in pigs. After such pigs are properly restrained a careful examination should be made to determine the location of the testicle. In addition to the usual instruments used in castration, suturing materials should be provided, and if the patient is an aged boar it is advisable to use an ecraseur or emasculator in crushing the cord.

Subcutaneously placed testicles in the groin may be removed through an incision of sufficient length made high up in the flank or by an incision parallel to the median line and as near the groin as possible. The operative area should be clipped, cleaned and painted with iodin. After the testicle is removed the incision is closed by a continuous suture and covered with pine tar.

In cryptorchids the operative field is prepared as above indicated and the incision made in the flank and extended through the peritoneum, after which the testicle is removed by scraping the cord or by the use of an ecraseur. The peritoneum and abdominal muscles are sutured with catgut and the skin with either heavy silk or linen and pine tar applied to the operative wound.

The after-treatment consists in placing the patients in clean quarters and supplying them with a diminished ration of palatable food.

SEQUELAE OF CASTRATION

Hemorrhage

Old boars are prone to bleed freely after castration unless the operator has used an ecraseur emasculator to crush the spermatic cord.

Violent exercise immediately after castration of mature boars

should be prevented. Small pigs rarely bleed sufficiently after castration to cause any concern. In case of severe hemorrhage as a sequel of castration it is necessary to restrain the animal and ligate the end of the cord or pack the scrotum and close the operative wounds by sutures. Packing in such cases should be removed in twenty-four hours.

Scirrhous Cord

Scirrhous cord has been relatively common in swine because of the failure to properly care for recently castrated swine and because of carelessness in castration.

This condition is manifested by an enlargement or tumefaction in the castration wound. The tumefactions vary in size and appearance. In some instances there are fistulous tracts and there may be a discharge.

Etiology.—The castration wounds are subject to a variety of infection because of their location and the nature and habit of swine. Various pyogenic bacteria gain entrance into the castration wound, and should the incisions be small and the wound margins closed by the inflammatory swelling an abscess may develop, the size of which will depend upon the tissue resistance. Scrotal abscesses in castration wounds are not serious if properly opened, drained, and cared for, but if the pus is allowed to accumulate it may infiltrate the surrounding tissues or, more probably, pass along the vas deferens, and ultimately enter the pelvic cavity and establish peritonitis.

The colon bacillus may also infect castration wounds and produce either suppurative or septic inflammation. In a few instances several pigs have been observed affected with septic disturbances resulting from colon infection in castration wounds. The lesions observed in septic infection consist of gaseous tumefactions containing inflammatory products. These cases usually terminate fatally, unless treatment is begun early. The treatment consists of opening the castration wounds, removing the necrotic tissue with a curette, and freely applying efficient germicidal agents.

The Bacillus necrophorus occasionally gains entrance to the castration wounds, but the successful infection by these germs is usually in the later stages of the healing process. The Bacillus necrophorus is anaërobic and probably is continuously eliminated in the feces. The lesions produced by this organism consist of a slow-going necrosis, the necrotic foci being surrounded by an inflammatory zone. A peculiar, offensive odor emanates from the lesions. The necrotic areas may

later show evidence of separation from the surrounding tissue, and ultimately the lesion may become desiccated and slough, leaving a dark-colored surface upon which tissue fragments and pus may accumulate. These cases may prove fatal, but more frequently the animals linger for some time, the surrounding tissue becoming tumefied due to the proliferation of fibrous tissue. In such cases there is a variable sized opening or unhealed surface. If the large fibrous mass is removed and incised it will be found to contain necrotic centers composed of fluid, semi-fluid, or caseous material. These centers are surrounded by fibrous tissue, the entire mass being made up of layer upon layer of fibrous lamellæ. The end of the vas deferens will be found involved in the mass, to which it usually adheres firmly, or to the external surface of the wound, by dense fibrous tissue. This condition in the beginning may be identified by the tumefaction and particularly by the bad odor of the discharge. Later the large lesion is observed with the characteristic putrid discharge from the open wound.

Treatment.—In the early stages the condition may be relieved by the energetic application of disinfectants, and if necrosis is present the excision or curettment of the necrotic centers. After the dense mass of fibrous tissue has formed, only the careful removal of the entire mass by operation is successful; and in this the greatet care must be exercised or the animal will bleed to death.

It is advisable to administer an anesthetic or perhaps preferably administer chloral hydrate per rectum to these cases before operating. In the early stages this condition may be corrected by carefully removing the diseased tissues. Proper after-care should be provided to prevent infection and recurrence of the condition. If the tumefaction is extensive and contains areas of necrotic tissue the entire mass should be carefully dissected away from the normal tissues. Hemorrhages should be controlled in these operations or the patient may die of shock or exhaustion. Such masses may be removed by an emasculator and thus diminish hemorrhage. The wound should be swabbed with iodin and packed with gauze. The packing should be removed in eighteen to twenty-four hours.

Actinomycosis

Actinomycosis may affect the scrotum of castrated swine, but is not common.

Parasites

Infestation of the castration wounds with screw-worms (larvæ of the Campsomyia macellaria) are very common in the southern part of the United States. These larvæ burrow into the tissues, thus mechanically injuring them and providing an avenue of entrance for various bacteria.

Lesions.—The principal lesion consists of an active, acute inflammation with or without the production of pus. The surrounding tissues are tumefied, hyperemic, hemorrhagic, and contain the larvæ. The extensive tumefaction developing within one or two days after castration is the most evident symptom. On a close inspection, larvæ

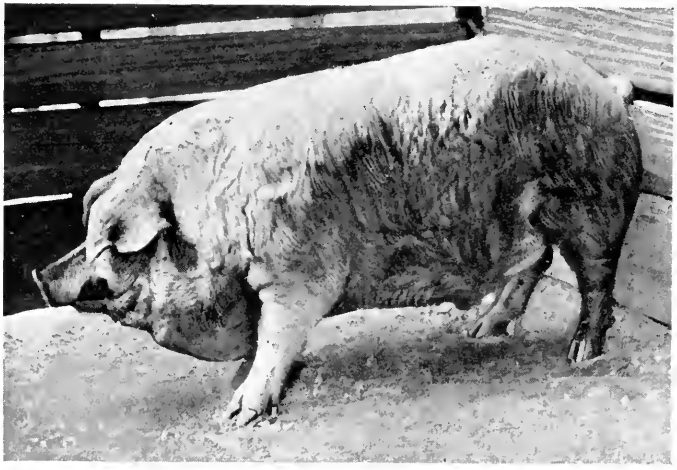

Fig. 106. ACTINOMYCOSIS.

may be observed near or upon the surface, and by manipulation of the lesion larvæ may be forced out upon the surface. In cases of screw-worm infestation there is a constant sero-sanguineous discharge that by attracting the female fly favors repeated reinfestation.

Treatment.—All that can be done in cases of screw-worm infestation is to support the strength and minister to the comfort of the animal and prevent a further infestation from the deposition of more eggs or larvæ upon the wound and patiently wait for the investing larvæ to reach the stage of development when they volun-

tarily leave the wound to pupate in the ground. This occurs in three to five days.

The application of chloroform, naphthalene or other chemicals to the wound is worse than useless. Such measures not only fail to effect the removal of more than a small percentage of the larvæ, but they also irritate the highly sensitive tissues and greatly aggravate the condition.

None of the ordinary fly-repellents has any deterrent effect upon the female of the screw-worm fly in the presence of fresh blood, either in recent wounds or in the discharge from screw-worm infested wounds. However, a mixture composed of turpentine one dram, phenol one dram and cottonseed oil four ounces is an effective repellent for this fly, and where there is a probability of screw-worm infestation it should be applied to fresh wounds and to infested wounds as long as the screw-worm larvæ are present and the sanguineous discharge continues. One application daily is sufficient.

Botryomycosis

The Botryomyces ascoformans also infects castration wounds in swine. This condition is very common in certain localities at some seasons. It is of a chronic, insidious nature. The castration wounds may heal and be apparently normal, the first indication of the condition being a slight enlargement of the scrotum. The enlargement persists and gradually increases in size until it is quite large; in some instances these masses may attain the size of a football. On examination of the affected pig a rather dense mass can be outlined, apparently adhered to the substructures but not attached to the skin unless the wound has failed to heal. These masses are found to be encapsulated with dense fibrous connective tissues. On sectioning the growth, many centers are found from one-half to two inches in diameter. These centers contain pus which may be caseous, and the various centers communicate by means of fistulous tracts.

Treatment consists of ablation of the entire mass, which is ordinarily not difficult as the lesion is subcutaneous and is definitely circumscribed.

Scrotal Hernia

Scrotal hernia is relatively frequent in swine. The condition occurs at the time or soon after birth and is said to be congenital in

about 90 per cent of the cases. It is occasionally observed in shotes or older swine, and is in such cases probably the result of injury. This condition consists of a protrusion of omentum or a portion of intestine into the scrotum between the protruded intestine will be found outside the tunica vaginalis reflexa. Scrotal hernia may be limited or extensive; in some instances the scrotum may be as large as a gallon jug. Raising the hind parts of the pig usually permits of a portion of the protruded structure passing back into the abdomen, and thus reduces the hernia.

Treatment.—This condition can be permanently relieved only by surgical procedure. It is preferable to operate on pigs under two months of age. Feed should be withheld from animals that are to

Fig. 107. Scirrhous cord due to botryomycotic infection.

be operated upon for from twelve to twenty-four hours. A solution of chloral hydrate should be injected per rectum twenty to thirty minutes before operating. Small pigs may be restrained by hanging them up by cords attached to the hind legs. Larger hogs will not submit readily to this mode of restraint but may be conveniently managed on a slight incline that can be readily provided for the purpose. Small animal operating tables are available for such operations and will be found very convenient.

The scrotum should be carefully examined to determine the nature and extent of the hernia. The operative area should be thoroughly

cleaned and antiseptics applied, after which an incision is made parallel with the median line or raphe and extended sufficiently low to insure good drainage. This incision should extend through the skin and dartos. If the amount of protruding intestine is limited in amount and is contained within the vaginal tunic the covered operation for castration will relieve the condition. The vaginal tunic with the contained testicle should be exposed by blunt dissection and the cord with its enveloping tissues clamped by compression forceps, using

Fig. 108. Multiple abscesses in Duroc boar.

care not to include any portion of the intestine, and then a ligature of heavy silk is passed through and around the cord and ligated. The cord is then severed about one inch distally from the ligature. It is also advisable to close the inguinal canal by catgut sutures. The scrotal incision should be closed with the exception of the lower portion by continuous sutures of silk or linen.

In cases in which the protruded intestine is large the operation is more serious. The animal should be prepared by withholding food

for eighteen to twenty-four hours. They should be given a rectal injection of chloral hydrate to diminish sensibility and be restrained in an inclined position with the head downward. The field of operation should be cleansed and painted with tincture of iodin. An incision is made over the inner abdominal ring three to four inches in length and parallel to the vaginal tunic, which is exposed by careful dissection.

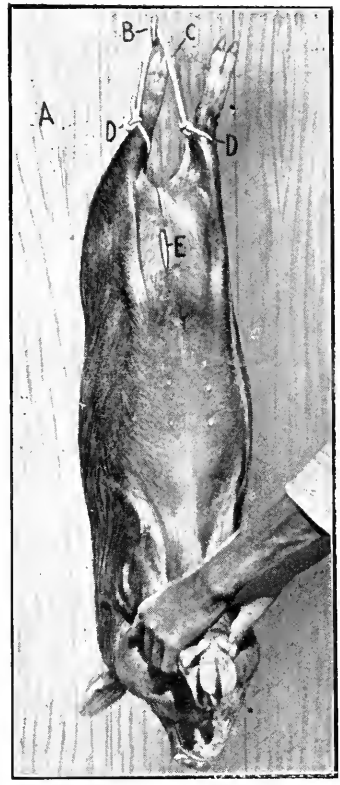

Fig. 109. Restraint for spaying sow belly method. (White's Castration.)

The hernia can usually be easily reduced if it has not already become so due to the animal's position. The cord should be ligated and severed, thus removing the testicle, after which the cord is passed into the peritoneal cavity and a catgut purse-string suture applied to the inner abdominal ring. The external incision is closed by continuous sutures.

Spaying of Sows

Unsexing of sows is not commonly practiced in this section of the country. Experiments have proved that spayed sows were more economic than entire females in the production of meat. The character of the meat is apparently not changed by spaying.

Spaying should be done on sows from two to four months of age. Feed should be withheld from twelve to twenty-four hours before operating. The patient should be restrained on an inclined table or by some other means so that the head is considerably lower than the hind quarters. They should be confined so that either flank is ex-

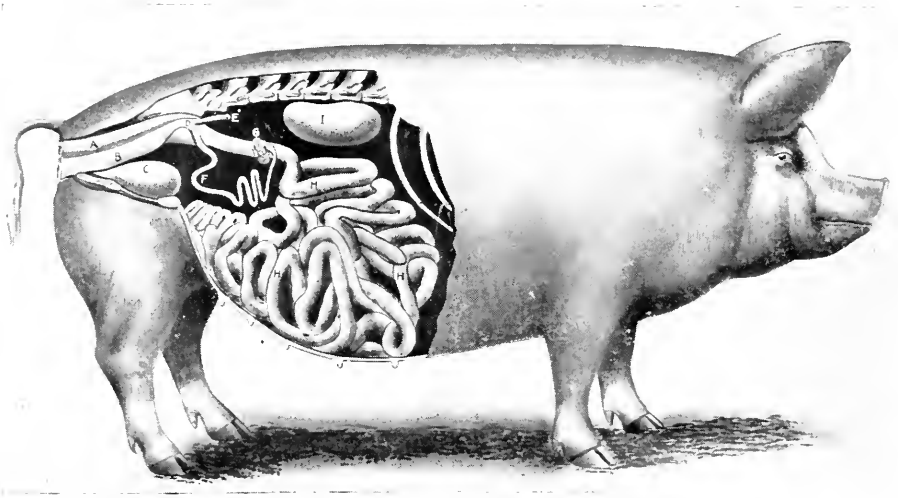

Fig. 110. Internal genital organs of sow (diagrammatic). A, rectum; B, vagina; C, bladder; D, uterus; E, left uterine horn; F, right fallopian tube and horn; G, ovary; H, intestines; I, kidney.

posed. After clipping the hair in the flank region, anterior to the angle of the ilium, the part should be cleansed and tincture of iodin applied. An incision is made through the skin, fascia and abdominal muscles, after which the peritoneum is punctured. The length of the incision should be determined by the size of the sow. Two fingers or the entire hand is inserted into the peritoneal cavity to locate the ovaries, which will be found suspended on a relatively long broad ligament which will permit of the ovaries being brought to the surface where they can be removed by means of serrated scissors.

It is not considered necessary to suture the peritoneum. The skin

and abdominal muscles should be united by three or four interrupted sutures. The wound should then be painted with tincture of iodin and with a fly repellent, and the sows placed in clean quarters.

Ablation of the Mammary Glands

Removal of the mammæ of swine is advisable when they are invaded with tumors, extensively lacerated or affected with actinomycosis, botryomycosis, necrobacillosis and some other infections.

Operation is indicated when the injury or disease process can not be relieved by therapeutic agents.

The animal should be properly restrained and narcotized by chloral hydrate injected per rectum. The operative field should be cleaned and painted with tincture of iodin. An incision should be made parallel to the median line over the central portion of the affected gland unless the skin is involved, when the incision should be so made as not to pass through the diseased portion. After the incision has been made and hemorrhage controlled the skin should be separated from

Fig. 111. TUMOR OF THE MAMMARY GLAND.

the gland and the gland from the underlying structures by blunt dissection. The larger blood-vessels should be ligated and the gland removed after hemorrhage is controlled and fragments of tissue re-

moved. A semi-elliptical portion of the skin should be removed from either side of the original incision so that the margin can be approximated by sutures. If the involved gland be extensively swollen it may be advisable to pack the wound; otherwise, it should be painted with tincture of iodin and drainage provided for and the wound closed by continuous sutures. A protecting coating of collodion or other substance will be found of value in preventing infection. The animal should be placed in clean quarters and provided with wholesome food and water.

Operation to Remove Swirls

A swirl is an irregular whorl of hair or bristles that usually occurs on the back, loin or croup of swine. Some pure-bred associations disqualify swine that have swirls. If swine with swirls are otherwise eligible for registry and are good individuals this disqualifying factor may be removed.

Such cases should be operated upon before maturity to avoid the development of scar tissue. The patient should be restrained in a crate or upon an improvised table. The swirl and the surrounding area should be cleaned and painted with tincture of iodin. By the use of a sharp scalpel an elliptical incision is made through the skin around the swirl. The long diameter of the ellipse being parallel with the median line of the body. The incision should be made obliquely through the skin in such a manner that the margins of the ellipse are of the same obliquity and can be overlapped without causing a ridge. The oblique margins are then approximated by interrupted sutures and supported by sutures well back of the incisions. The operative wound is painted with tincture of iodin and covered by a protecting layer of collodion and the animal placed in clean quarters where the possibility of infection will be reduced to a minimum.

OBSTETRICS

The characteristics of the breeds of swine are being constantly changed and the type of any pure-bred hog is materially different from the original wild hog. The changes incidental to the building of breed types have been, in some instances, at the expense of characteristics that insured the preservation of the species. The original wild hog and, in fact, the razor back type of today, have little if any

difficulty in farrowing. The characteristics, particularly of the lard type of hog, are such that the space for a gravid uterus is encroached upon and the channel through which the pig must be expelled during farrowing is proportionally smaller than in the original hog. These conditions are responsible for the difficulties of farrowing that are so commonly encountered by the general practitioner. The practitioners in hog-raising sections are finding that swine obstetrics requires patience, care and skill if favorable results are obtained.

AGE OF PUBERTY AND ESTRUM

The appearance of puberty takes place at slightly different periods in different breeds. Puberty is indicated by the appearance of estrum or heat. During this time the mucous membrane of the vulva and vagina becomes congested and there is a gelatinous discharge from the vulva. Sows in the period of estrum are restless and constantly moving about, apparently seeking the opposite sex. The estrual period usually persists for from twelve to forty-eight hours.

The period of heat sometimes fails to occur in gilts and in sows that have aborted. The cause of this condition in gilts may be due to inbreeding, excessive fat, lack of sufficient exercise or diseases of the genital organs. If the defect be due to overfeeding or lack of exercise it can usually be overcome by diminishing the feed and making the conditions such that abundant exercise will be taken. It is difficult to overcome this condition when it is caused by inbreeding or diseases of the genital organs. It is advisable to administer such agents as yohimbin and strychnin in some form in the feed to those cases in which the individual is a good breeding type. Yohimbin may be obtained in the form of an elixir or in tablet form. The dose of the elixir is from one to two drams twice daily; each tablet as usually prepared contains a single dose and one tablet should be given three times daily. The strychnin may be given in the form of the elixir of iron, quinin and strychnin, using one to two drams twice daily in slop or as nux vomica, using one to two drams twice daily, in the slop.

The failure of the occurrence of estrum due to previous abortion may be corrected by overcoming the diseased condition of the vagina and uterus, which is described in detail under the topic of retained placenta.

GESTATION PERIOD

The gestation period in the sow varies from 110 to 120 days. The first gestation period is usually about 112 days, and aged sows may not farrow until the 120th day after conception.

ANATOMY OF THE FEMALE GENITAL ORGANS

The ovaries are irregularly lobulated, due to the prominence of the graafian vesicles. The uterus is supported by a large broad ligament. The uterine horns are long and are the portion of the uterus that contains the fetal pigs. The blood-vessels of the uterus, through which the fetuses are supplied with nutrition, are irregularly arranged in tufts, particularly in the horns. The body of the uterus is short and completes the communication between the uterine horns and the vaginal canal. The vulva is relatively small and contains the ducts or canals of Gartner.

The mammary glands, ten or twelve in number, are arranged serially on either side of the median line. Each gland has a separate teat which is pierced by openings.

The fetal membranes are those structures between the fetus and the uterine mucosa. They are three in number and from without inward are: the chorion, allantois and amnion. Each fetus is completely enveloped with separate membranes during the first part of the period of gestation, although the chorion and parietal portion of the allantois of each fetus overlap the same membranes of the adjacent fetus. In the later period of gestation there is apparently a fusion of the chorion and its attached parietal allantois membrane with the corresponding membranes of the adjacent fetuses and at the same time there is a solution of the membrane in most cases within the fused areas excepting the margin, and the allantois space thus becomes continuous and is common to all of the fetuses within the gravid uterus.

The chorion is the most external, is a closed sac, and assumes the shape and contour of the horns of the uterus. This membrane is principally concerned in the supply of nutrition to the fetus.

The amnion, also a closed sac, is the innermost membrane and completely envelops the fetus. This membrane secretes and retains a fluid, the amniotic fluid, which gradually increases in amount and just prior to parturition is of sufficient volume that the fetus literally

*The umbilical cord is the means of communication between the fetus and uterus. It is composed of embryonal connective tissue, which supports the urachus, arteries and veins.

floats in it. This fluid diminishes shock or injury to the fetus in utero and also serves as a lubricant in the vaginal canal in parturition. The allantois is a double membrane, one portion being applied to the internal aspect of the chorion and the other to the external aspect of the amnion. The two membranes form a constrictor tube, the urachus, which extends into the abdomen of the fetus through the umbilical opening and thence to the anterior portion of the bladder with which a communication is provided. Thus, the allantoic space serves as a urinary reservoir.

The umbilical cord is the means of communication between the fetus and uterus. It is composed of embryonal connective tissue, which supports the urachus, arteries and veins.

Parturition

The symptoms of parturition consist of congestion and tumefaction of the mucous membrane of the vulva and enlargement of the mammæ. The primary symptom of parturition is restlessness, and the sow will usually make a bed before she assumes the lying posture.

The expulsion of the fetuses from the uterus is the result of the combined muscular activity of the uterus and abdominal muscles. Just prior to the time that the muscular contractions begin, in normal animals, the cervix of the uterus relaxes and several fetuses will be delivered in a relatively short time. If expulsion is delayed while the fetus is in the vaginal canal the pig may be dead because of the strangulation of the blood supply through the umbilical cord and the cessation of respiration while the pig is in the canal. Such pigs may be revived by cleaning the mouth and nostrils and by the institution of artificial respiration which it may be necessary to continue several minutes.

DIFFICULT PARTURITION—DYSTOCIA

Difficult parturition may be due to a variety of conditions, some of which are known and may be overcome. Some of the conditions that cause or are associated with dystocia are: the breeding of gilts that are too young; the mating of young gilts with old boars; the mating of small frame sows with large coarse boars; allowing the sow to become too fat; requiring insufficient exercise of pregnant sows; constipation and impaction. In addition to the foregoing, dystocia is occasionally the result of malformation of the pelvis or abnormality of the musculature and cervix of the uterus.

One difficulty with dealing with dystocia in sows has been the failure of the farmer to call the veterinarian promptly. In those cases that have been in labor for twelve to twenty-four hours the services of the practitioner will probably not be of much value, because of the swollen condition of the genitals, due to infection.

In those cases in which the genitals have not been injured or are not infected, good results have been obtained by the use of pituitrin extract. This product can be obtained in one-mil ampoules which comprises a dose and should be injected intramuscularly. This dose can be repeated in twenty to thirty minutes. Pituitrin has also been reported to give good results in some of the dystocia cases. This is a compound in which the active principle is ergotin, quinin and urea hydrochlorid. The pituitrin is supplied in one-mil ampoules which constitutes a dose, or it may be obtained in larger containers. This product should be injected into the muscle and the dose can be repeated every twenty or thirty minutes. It will be found advantageous to dilate the genitals with warm water or an effusion of slippery elm bark.

It is difficult to assist in difficult parturition in the sow because of the smallness of the vaginal canal. Some practitioners employ a small boy with long fingers and a slender hand as an assistant in these cases. Instrumentation in dystocia of sows has not been very successful with the majority of general practitioners. The style of instrument selected varies with different operators, but Day's pig forceps or Colson's improved pig forceps are probably as well adapted as any that are on the market. In fact, some practitioners use a loop of wire passed through a small pipe and obtain good results.

The sow should be placed in as clean quarters as can be provided, and the external genitals washed with warm antiseptic solution prior to the application of lubricants or the use of forceps. After the field and operator's hands have been properly prepared, one or more fingers may be inserted into the vaginal canal for the purpose of directing the forceps in a fishing game of chance which is sometimes successful.

CESAREAN SECTION

This operation is frequently successfully performed on sows if the operation is done promptly in dystocia cases. Good results will probably not be obtained if the patient has been in labor for more than eighteen hours, and the operation will be more successful if performed

within the first six hours of labor. An unfavorable prognosis should be given if the temperature is 105° F. or above.

Anesthesia

The administration of chloroform or the various chloroform mixtures is not satisfactory, as swine are especially susceptible to chloroform poisoning. Chloral hydrate injected per rectum usually produces sufficient stupor so that this operation can be successfully performed. From one to four drams of chloral hydrate dissolved in water is the usual dose required for swine. It usually requires about twenty minutes for chloral to produce its action. Some practitioners do not use any anesthetic in performing this operation, but it is probable that better results will be obtained where anesthetics are employed.

Restraint

The patient should be placed on either the right or left side in a horizontal position and properly secured. The front legs may be secured to a post and the hind legs held by an attendant.

Instruments

Curved needles, two or three threaded with silk and the same number threaded with catgut, a scalpel, a long forceps, several smaller compression forceps, one or two pairs of scissors, clean towels, sterile gauze, absorbent cotton and a vessel for antiseptic solution is usually sufficient equipment for this operation.

Technic

The urine should be drawn, the area in the flank just posterior to the last rib is shaved or clipped, cleansed and painted with iodin. An incision through the entire abdominal structures is made about midway between the external iliac spine and the last rib, the direction of the incision being obliquely downward and forward and about four inches in length. Hemorrhage should be controlled. The skin surface adjacent to the incision should be covered with towels or clean cloths before introducing the hand. The location of the fetuses should be determined by manipulation. By gentle traction the gravid horn should be brought to the surface and the condition of the uterus determined. If both horns are gravid it is advisable to make a care-

ful examination of each of them before proceeding with the operation.

HYSTEROTOMY

If live fetuses are found in the gravid uterus and there are no indications of injury or infection it is advisable to perform hysterotomy. If both horns are gravid, the one on the side in which the abdominal opening has been made should be brought onto the surface that has previously been protected with clean cloths. An incision about six inches in length is made longitudinally on the dorsum over the fetus nearest the uterus. The gravid horn must be maintained in such a position that none of the fluids or contents of the uterus will contaminate the incisions of the operative wound or the peritoneum. All fetuses in the same horn can by manipulation be removed from the one opening. All fragments of placental membranes must be removed. It is sometimes possible by careful manipulation to remove the fetuses from the opposite horn through the one opening, but if such is found impossible the operation should be repeated on the opposite horn. Before suturing the uterine incision all fluids or fragments of placenta must be removed. The incision should be closed with Lembert sutures, using catgut. The operative wound should be painted with tincture of iodin and the peritoneum sutured with catgut. The skin should be sutured with heavy silk or linen and the surface coated with collodion or pine tar.

If live pigs are delivered they should not be permitted to suckle for several hours.

Hysterotomy patients should be placed in clean, comfortable quarters and fed sparingly.

HYSTERECTOMY

If on examination of the gravid uterus the fetuses are found to be putrid in one or both horns and there is danger of septic infection, it is advisable to perform hysterectomy. The same general plan of procedure that has been described for hysterotomy should be followed. Special precaution should be taken to prevent leaking of any of the content of the gravid horn into the body cavity. After the gravid horn has been brought to the surface two pairs of strong forceps are clamped about one inch apart upon the broad ligament adjacent to the ovary. The tissues between the forceps are severed by means of scissors and the remaining attachments of the broad liga-

ment can be easily broken down by blunt dissection and the entire horn freed. Two heavy compression forceps are clamped upon the uterus about one inch apart after all fluids have been forced out by manipulation. The uterine body is then severed and the broad ligament on the opposite horn is bluntly separated up to the region of the ovary where two compression forceps are clamped and the tissue severed between them, thus releasing all attachments of both horns and a portion of the body of the uterus. The severed structures in the region of the ovaries are ligated with catgut and the stump end of the uterus, after being swabbed with tincture of iodin, is securely sutured with catgut. Some operators prefer to fix the sutures by means of needles or otherwise.

The abdominal wound is sutured as previously described in hysterotomy. Hysterectomy is a much more serious operation than hysterotomy, and the percentage of recoveries will vary according to the extent of septic infection or intoxication that exists at the time of operation.

Such patients should be given the best care possible and fed lightly on slop feeds.

ACCIDENTS OF PREGNANCY

Some interesting conditions have been observed in the uterus of sows. If several hundred uteri are examined where it is convenient, as on the killing beds of an abattoir, some unusual conditions will be noted. Cases of mummification of one or more fetuses within the uterus are relatively common. It appears as though the sow is not as susceptible to putrefactive changes in the uterus as most other animals.

Prolapses of the vagina and uterus and uterine hernia or rupture are not as common in swine as they are in horses and cattle. Most cases of prolapse of the vagina and uterus terminate fatally before the practitioner arrives, because of the severe hemorrhage.

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